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A TAXONOMICAL STUDY OF THE NAIDIDAE

BY

CHRISTINA SPERBER

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ALMQVIST & WIKSELLS BOKTRYCKERI AB

A TAXONOMICAL STUDY OF THE NAIDIDAE

INAUGURAL DISSERTATION

BY

CHRISTINA SPERBER
FIL. LIC., NORRL.

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A TAXONOMICAL STUDY OF THE NAIDIDAE

By
CHRISTINA SPERBER
(Uppsala).

With 21 Plates and 29 Figures in the text.

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Preface.

On publishing this study it is my pleasant duty to thank my teacher, Professor Nils von Hofsten, for all the kindness and help he has shown to me. My gratitude is also due to my teacher, Professor Sven Ekman, the Director of the Zoological Institute, Uppsala, Professor Sven Hörstadius, the Professor of comparative anatomy, Gösta Jägersten, and the deputy Director of the Institute, Professor Per Eric Lindahl.

It is a cause of deep regret to me that I can no longer thank the late Professor Sixten Bock, the Museum of Natural History, Stockholm, for his great interest and help, especially in providing material which was difficult of access, and the late Dr. Leo Černosvitov, for his great kindness and good advice.

To Miss Amy Wästfelt, who cut most of my sections and drew my figures in Indian ink, and to Mr. F. J. Taylor, B. Sc., who revised my style, I also wish to express my gratitude.

Uppsala, April 1948

Christina Sperber.

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I. Introduction

The present paper is an attempt at a revision of the family *Naididae* on a phylogenetical basis. For this purpose comparative morphological studies have been carried out on as many species as possible, consisting almost exclusively of those which I have been able to collect in Sweden. Of the about 107 species considered valid in this paper, I have collected 37 spp. in Sweden. Studies at, or loans from, foreign museums were rendered impossible by the war (except a small loan from Berlin, and one from Finland).

Thus I have had no first-hand experience of the tropical forms, or forms confined to other continents. I have, however, tried to compensate as far as possible for this deficiency by studying the literature, so far as it has been accessible. It is very probable, however, that owing to the war the latest literature has not reached Sweden; in fact, I have seen only one foreign paper printed later than 1944.

Morphological studies have been made chiefly on the following organs: the setae (shape, number and position), the alimentary canal (shape and histology), the vascular system (distribution), and the sexual organs (shape, histology and position). Usually the nephridia have not been investigated more closely, as their shape is generally very similar in the diverse species. I have usually given no descriptions of the nervous system. The shape of the brain (which was considered by PIGUET as a good specific character) varies much with the state of contraction, both in living and preserved material. The real differences seem as a rule to be minute. As far as it has been possible to ascertain, this applies also to the distribution of the nerves, though they are difficult to study adequately, and have been but little studied, as they did not promise to give any significant characters. Observations on the body wall (except the clitellum) and the coelom have only been made to a small extent.

In addition, observations have been made on the mode of locomotion, and certain parts of the alimentary canal have been examined with the aid of intra-vital staining.

So far no attempt has been made in the literature to apply modern taxonomical methods, based on the study of geographical variation, to the

Oligochaeta. This is, in fact, still generally impossible, as the material collected has been far too small, and the facts known about each form too scanty to allow of any delimitation of possible geographical races. In a few cases, when the available facts have been more ample, a tentative subdivision into races has been attempted in the present paper. The old terms "variatio" and "forma" have been wholly dropped, as leading to confusion, but as full accounts as possible are given of the variation within the species.

Technique.

Collecting. As the Naids occur mostly amongst aquatic vegetation, or in tubes attached to twigs, dead leaves, or similar objects, the most successful way of collecting them has usually turned out to be the sampling of such matter from the water. It has then, either immediately, or afterwards in the laboratory, been shaken repeatedly in a flat glass dish with water, whereby the worms are washed out into the water and may be removed with a pipette. The water is then changed, and the process repeated, until no more worms appear. With this method even the smallest species are easily found, if a good light and a dark back-ground are used. A low-power binocular microscope may also be used. Bottom samples have been taken either by hand, in the case of shallow water, or with the aid of a hoop-net of wire mesh with a test-tube attached to its bottom opening. These samples have been shaken with water in small portions and searched in the manner described above. (Whatever the method of collecting, incompletely full-grown buds are often prematurely separated from the mother individual before such characters as eyes, or an abrupt stomachal dilatation have yet developed, and such buds may thus easily be mistaken as belonging to some other species by an inexperienced investigator. This has apparently been the case with some species described as new in the literature; cf. p. 104.)

Observation. Observations have been made extensively on living material (with a low-power binocular microscope, and an ordinary high-power microscope) concerning movements, habit etc., as well as the internal anatomy. The living material was stained in some cases, chiefly with neutral red. The dye was mostly used in a 0.01 % solution.

As a rule observations as well as fixation have been undertaken on non-narcotized specimens. As pointed out by STEPHENSON (1923, p. 9) the animals are apt do die and disintegrate very rapidly when treated with anaesthetics; among the species I have studied, the *Dero* were especially sensitive — their posterior end began to disintegrate before the anterior end had ceased wriggling. Various anaesthetics were tried, such as cocaine, svedocaine, chloral, and a solution containing picric acid, but none proved advantageous.

Fresh material as far as possible was used for the study of the setae, too. It was pressed after the method of PIGUET (1906) which has been generally used by investigators of the family. Instead of allowing the water to evaporate from under the cover-glass, which is a fairly slow process, one may cautiously press the glass, and remove the superfluous water with a scrap of linen. — For the study of the details of the setae, and for permanent setal preparations, a saturated solution of potassium acetate prepared according to SÖDERSTRÖM (1920, pp. 20—21) has been used. This fluid has a lower refractive index than glycerine, or Canada balsam, and makes small details easily visible and measurable. It is added gradually to the pressed aqueous preparation, and the superfluous solution removed. — Old, dried-up setal preparations may often be restored with this solution.

For the closer examination of setae in preserved material, especially when fixed in alcohol, maceration with potassium hydroxide has proved favourable. The animal is placed on a slide, in a drop of the saturated solution. After some time, which varies with the size of the worm and the age of the material, from a couple of minutes to hours (it has to be tried out for each individual case) the solution is changed for distilled water, whereby the body tissues are rapidly disintegrated. A disadvantage is the swelling and the abnormal flexibility of the setae caused by the process. Thus, the setal thickness cannot be judged from such preparations, but lengths, and especially the relative length of teeth etc., can be measured.

Whole mounts have been stained with haemalum or eosin, and mounted in Canada balsam. I have tried methylene blue and silver impregnation for the nervous system, though with small success.

For sections, various fixatives and stains have been tried. Alcohol, formol, sublimate, the fluids of Zenker, Bouin, Flemming, and Meves, and that recommended by SCHUSTER (1915) have been most extensively applied for fixation. Fixation with Flemming's strong fluid, and staining with Heidenhain's iron haematoxylin (with or without counter-staining with orange G or picrofuchsin) has proved most favourable for histological details, but the stain fades considerably after some years. Bouin's fixative gives good pictures, but the cell-boundaries are generally not shown. Zenker's fluid is a good all-round fixative, with Ehrlich's haematoxylin and eosin for staining. The thickness of the sections has generally varied from 3 to 5 μ.

Photographs have been made with a Zeiss large horizontal micro-camera from both living material and sections.

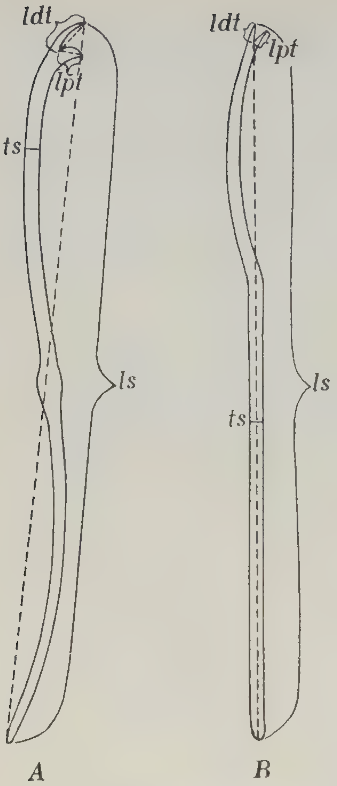

Fig. 1. Distances measured in the setae. *A* ventral or dorsal crotchet, *B* needle seta. *ldt* length of distal tooth, *lpt* length of proximal tooth, *ls* setal length, *ts* setal thickness.

Measuring. Measurements of sexual organs have been made from sections. They are naturally only approximate, owing to the contraction of the animals, and to the difficulties in measuring winding ducts, etc., and they vary greatly with the stage of maturity.

The setal length has been measured in a straight line between the extremities. The length of the teeth was measured from the tip to the extremity of the angle between the teeth (Fig. 1 *A*). (In the text and the tables, the teeth measurements are written $\frac{\text{distal tooth}}{\text{proximal tooth}}$.) The thickness of crotchet-shaped setae (ventral and dorsal) has been measured at a point between the nodulus and the curve at the base of the teeth, where the margins of this type of seta are usually parallel (Fig. 1 *A*). The thickness of needles of the *Nais* type is measured somewhere below the nodulus, as the shaft is here equally broad from the nodulus to the proximal end (Fig. 1 *B*).

Whenever possible, mean lengths have been calculated for the setae of some segments. The variations in length with the position of the setae, however (cf. below), make the value of such statistics fairly small. To give it any significance, one ought to measure certain setae in certain bundles, e. g. the outermost and innermost seta in the left bundle of some specified segments, from a large collection of material, and calculate the mean, and the standard error, etc. for each seta. This would demand a lot of time, and necessitate the destruction of a large quantity of living material. This is not often possible to obtain, especially as the material ought to be taken from several localities, as within any one locality the population must necessarily consist most often of one or a few clones.

II. Anatomical Section

The setae.

The ventral setae. The ventral setae are double-pronged "crotchets" with a nodulus (rarely one prong is absent; see below). They are as a rule present in all segments from II onwards, and are often all very similar to each other throughout the body. There are, however, as a rule, more or less distinct, though often minute, differences between the setae of a bundle, and between those of the anterior part of the body, and those towards the hinder end. As STEPHENSON (1915 b) has shown in some genera, the nodulus is situated more distally in the outermost setae of a bundle, and more proximally in the innermost setae, so that the tips are all on a level when the setae are extended. This seems to hold for all or most genera. Consequently, the outermost seta is also often the longest, and it is also the thickest of the bundle, the innermost being the thinnest, and also often the shortest. There is often a gradual change in length and length difference of the teeth, though the difference is sometimes very small (cf. Pl. XVIII, fig. 2, and Fig. 13, p. 123). Toward the posterior end of the body, the setae usually grow somewhat shorter and thinner, and the difference in length between the teeth, if there is one, often diminishes.

Sometimes there is a marked difference between the setae of those segments at the anterior end, which are formed in a budding-zone, and those of the remaining segments. The former are then usually longer, straighter, and slenderer than the latter, with longer teeth, and a more proximal nodulus. The difference is well marked in most species of *Nais*, many species of *Dero* (Pl. XVIII, figs. 1, 2) incl. *Aulophorus*, and also in *Pristina aequiseta*, but only faintly so in *Allonais* and some species of *Pristina* (*Pr. foreli*, *synclites*, *rosea*, *sima*). In some species of *Nais*, e. g. *N. pardalis*, *bretscheri* (cf. Fig. 13 *A—D*, *N*, *P*), *barbata*, *pseudobtusa*, this difference is striking, especially so in *N. behningi*, where the anterior setae are 1 $^1/_2$ times as long, but only half as thick, as the rest, with the distal tooth enormously long and strongly curved, the proximal one being reduced. In *Haemonais* and *Branchiodrilus* the transition between the two types, when present, is less abrupt, and takes place farther backwards.

In some genera, only the setae of II differ distinctly in shape from the rest. This is the case in *Vejdovskyella*, *Ripistes* (where the setae to the rear are unusually straight, with an abrupt proximal bend), and several species of *Pristina*. In the latter genus, one group of species (cf. p. 242) has the setae of II and often also those of III differing from the rest, but most often all the setae in this genus are approximately equal, except that those of the first segments may be shorter, their length increasing gradually backwards.

In *Chaetogaster* all the setae have a peculiar form, being fairly straight, with an abrupt proximal bend; this is especially accentuated in the *Ch. limnaei* group, where the teeth are also strongly curved (cf. p. 61, Fig. 7 *F*). Here, the number of setae per bundle is unusually high (up to more than 20). The last-mentioned characters are probably adaptations to the special mode of life. In *Stylaria lacustris* all the ventral setae have a unique shape, with two sharp bends (Fig. 15 *L*, p. 145).

In some genera a number of segments are provided with specially enlarged setae, sometimes meriting the name of "giant setae." In *Nais bretscheri* and *pardalis*, and *Vejdovskyella intermedia*, the enlarged setae appear in a varying number of segments posterior to V. The extension of this setal type apparently varies with the age of the animal (cf. pp. 141, 145, Fig. 13 *E*—*M*, *O*). In *Pristina aequiseta* and *evelinae* the giant setae are confined to one or two segments in front of the former budding-zone, and may perhaps be connected with genital setae, although they are also present in immature individuals (cf. pp. 231, 232, Fig. 25). In one or two races of *Pristina longiseta* the setae of III are more strongly enlarged than usual.

In *Chaetogaster setosus* all the setae are reported to be simple-pointed, and in *Ch. krasnopolskiae* one prong is reduced (cf. pp. 71, 72). In *Homochaeta naidina* or forms closely related to it (*Paranais heteroseta* and *Osaka shimasakii* Kondô; cf. p. 92), all or some of the setae may be simple-pointed.

In *Chaetogaster* the ventral setae of III—V have been lost. In *Vejdovskyella comata* the ventral setae of III are usually absent, and those of IV weaker than the rest.

For the occurrence and shape of the genital setae see pp. 52—54.

The hair setae. Hair setae are present in all genera except *Chaetogaster*, *Amphichaeta*, *Paranais*, *Homochaeta*, *Uncinais*, and *Ophidonais*. Generally they are smooth, slender, and more or less flexible. In most members of the genera *Pristina*, *Stylaria*, *Ripistes*, and *Vejdovskyella* the hairs are provided with one or two rows of saw-teeth, and in *Vejdovskyella* the hairs are also very stout and rigid (cf. p. 139, Fig. 15 *E*). In *Dero pectinata* the hairs appear plumose owing to the presence of serrations on one side, which are long and very close together (Aiyer, 1930; cf. p. 187).

In some species of *Slavina* the hair setae of VI are extremely elongated. This is also the case with the hairs of III in *Pristina longiseta*, those of VI—VIII in *Ripistes parasita* (cf. p. 144; here projecting from extremely large and deep-sunk setal sacs), all the hairs except those of II—VII in *Pristina biserrata*, and all, except those of the hindmost segments, in *Branchiodrilus hortensis*. — In VI—VIII in *Ripistes parasita*, and in all segments in *Arcteonais lomondi*, the number of hair setae per bundle is unusually high, often approaching 20.

The needle setae. Needle setae seem to be present in all genera, except *Chaetogaster*, where all the dorsal setae have disappeared. They are double-pronged crotchets, resembling the ventral ones (or simple-pronged in a few cases, when the ventral setae are so) in *Amphichaeta*, *Paranais*, *Homochaeta*, *Uncinais*, and *Piguetiella*. This may be connected to a certain degree with the mode of life of these forms—they are strictly confined to the bottom, crawling in mud or sand, neither swimming nor floating. The hair setae are absent (cf. above) or very short (*Piguetiella*; cf. p. 152) in these forms, which also suggests this conclusion.

In most cases the needles are more or less modified, more "needle-like." In *Haemonais* they are comparatively slightly modified, only slightly straighter, and with teeth somewhat less curved than in the ventral setae (Fig. 18 *C*, p. 159). In *Specaria* the difference is considerably greater (cf. p. 96, Fig. 9). Simple, straight or faintly curved needles with or without an inconspicuous nodulus are found in *Vejdovskyella*, *Slavina* (here faintly bifid in one species), *Stylaria*, *Ripistes*, *Arcteonais*, *Stephensoniana*, and *Branchiodrilus*. In *Ophidonais* they are very stout, straight, obtuse, and simple-pointed or with a hint of a bifurcation. In *Pristina* the needles are fairly straight, and show a series from double-pronged, with very straight, short or very long teeth, and a nodulus, to quite simple, hair-like forms. In the remaining genera the needles are characteristically bayonet-shaped, the part proximal to the nodulus being straight, the distal curved. In *Nais* there is a series from double-pronged through simple-pointed, obtuse to very sharply pointed needles (and a quite deviating type in *N. schubarti*, p. 129, Fig. 14 *D*). In *Dero* there are two series from common double-pronged needles through types with a "webbing" or intermediate teeth, to "palmate" types (cf. p. 159). In *Allonais* there occur, besides the common type, forms with very long, stout teeth, straight or curved in an odd manner (*A. chelata*; Fig. 21 *E*).

The alimentary canal.

The alimentary canal in the Naids consists of mouth cavity, pharynx, oesophagus, stomach, and intestine. The mouth cavity has a low, nonciliated epithelium.

The pharynx. The most characteristic feature of the pharynx in the Naids (except the *Chaetogastrinae*) is the presence of a dorsal dilatation or diverticulum, covered by gland cells. The diverticulum, which is highest at its front end, and continually flattens out backwards, often begins in II and stretches through III (and sometimes slightly into IV), as in *Nais*, *Specaria*, and *Pristina*, but it may occupy a considerable part of IV, too, as in *Stylaria*, *Vejdovskyella*, *Ophidonais*, *Dero s. str.*, and *Haemonais*. In *Slavina*, *Ripistes*, *Piguetiella*, and probably *Allonais*, it occupies, as far as I have been able to ascertain, III—IV, in *Aulophorus* III—V, and in *Para-*

nais and *Uncinais* only III. Thus, its size and situation vary rather considerably. Its depth, and width vary with the state of protrusion and contraction. In undisturbed worms, not swallowing food or water, it has a very narrow, vertical or horizontal lumen, almost closed off from the rest of the pharynx.

The wall of the diverticulum consists of a high columnar epithelium of narrow cells with slightly basal nuclei (Pl. V, fig. 5, Pl. VI, fig. 1, Pl. X, fig. 2, Pl. XV, figs. 1, 2 *ec*, *nec*). SZARSKI (1936 b) remarks that the cell-borders can scarcely be seen, and that the cells are full of fibrils. In my preparations the borders are often visible, but no fibrils. The cell-contents are finely granular and vacuolated in the more basal part (about MARCUS' concept of these cells see p. 15). The cells bear a fairly low, but very dense layer of cilia. These are stated by SZARSKI to be stiff and immobile, but in the living animal, pressed under a cover-glass they are seen to move violently, and they are active during the taking of food (see p. 35). In sections they are often seen to be covered by a mucous secretion, as stated by SZARSKI and others. According to MARCUS (1943) the species of *Aulophorus* which form their tubes by cementing together with mucus, foreign particles collected with the everted pharynx, have a pharynx roof in the shape of a circumscribed plate of high cells, like the *Enchytraeidae* and *Phreodrilidae*.

In most Naids only the dorsal wall is shaped as described above, but in *Stylaria* and *Dero* a strip of the ventral wall from the third segment to the beginning of the oesophagus has quite the same structure, too. The lateral walls, and in most Naids the ventral wall, show a similar structure to that of the buccal cavity, with a low epithelium devoid of cilia. Towards the oesophagus they change a little before the dorsal wall changes, so that there is a small part of the gut built mainly as the oesophagus, but with the pharyngeal epithelium mid-dorsally. (According to MARCUS all the Naids of his material had a ventral ciliated strip; in my material this is not so.)

The muscular investment of the diverticulum is fairly strong mid-dorsally, and it is connected with the dorsal body wall by numerous muscular strands.

The "corps gustatif" described by DEHORNE (1916, p. 82, Fig. 45 r. s.) seems to be nothing but the thickened wall of the border between mouth and pharynx, immediately in front of the dorsal diverticulum. Here the cells are high and columnar, and fairly similar to those of the pharynx, though they lack cilia (D. found short ones). I have not been able to trace the "masse ganglionnaire" described by her as lying below (?) them.

In *Chaetogaster* and *Amphichaeta* the pharynx is confined to II—III. It has no dorsal diverticulum, and no ciliation, while strong muscles radiate from it towards the body-wall (cf. VEJDOVSKY, 1884; DEHORNE, 1916, a. o.).

The pharynx has been defined rather differently by different authors. VEJDOVSKY (1884, p. 101) considered the pharynx as occupying all the first 4 seta-bearing segments, i. e. those formed in a budding-zone, except in *Pristina*, where it would occupy only II—III. It is obvious, that he places the limit at the point where the gland-cells cease ("der in den vorderen 2 Segmenten befindliche Theil verdickt an seiner Dorsalseite zu einem Tonnenförmigen, muskulösen und ausstreckbaren Rüssel, während der hintere, in dem 3. und 4. Segmente gelagerte Theil äusserlich mit einem drüsigen Peritoneum belegt ist"); in *Pristina* there are no gland-cells behind the dorsal diverticulum. STEPHENSON (1930) gives no opinion on the matter, but (in 1922 a) he gives a figure (op. cit., Fig. 12) of the dorsal pharyngeal wall, where the columnar epithelium grows thinner backwards, where he considers transition to the oesophagus to take place. He thus seems to confine the pharynx to the part distinguished by a dorsal columnar epithelium.

According to MICHAELSEN (1928), the pharynx is confined to II—III, or somewhat more, and is characterized by a dorsal diverticulum ("Schlundkopf") and a columnar epithelium. SZARSKI (1936 b) has the same definition. STOLTE (1933—40) on the other hand is of the same opinion as VEJDOVSKY: "Bei den limicolen Formen der Gattungen *Nais*, *Stylaria*, *Ophidonais*, *Slavina*, *Dero* und *Vejdovskyella* erstreckt sich der Pharynx über vier Segmente, die dorsale Verdickung über zwei." He also quotes SEMPER (1877) who is said to have stated that this limit is not always constant, and that it does not correspond to the limit between "head" and "body-segments" in the budding Naid. I have, however, not been able to find this passage in the paper in question.

In my opinion there is no doubt that the pharynx is limited to that part which has dorsally a columnar epithelium and a diverticulum. Histologically there is dorsally, as well as ventrally, a quite distinct difference from the epithelium of the following part, the oesophagus, which is generally quite uniform from beginning to end.

The oesophagus. This part has a lower epithelium which is not exactly cubical, the cells being usually fairly high, rather irregular and deeply staining (Pl. VII, fig. 2). It is provided with long, active cilia, much more closely-set than those of the following parts, though not so closely as those of the pharynx. Its muscular coat is weaker than that of the pharynx. Behind septum 5/6 the intestinal plexus and the chloragogen cells generally appear, corresponding to the number of segments which are formed anteriorly by budding (about exceptions see pp. 34, 36). The length of the oesophagus varies considerably, owing to the difference in length of the pharynx, and the beginning of the stomach. It may occupy from about 2 to about 5 segments. It usually begins in the hind part of the last pharyngeal segment, and its posterior end does not correspond to any segmental limit either. In the *Chaetogastrinae* the oesophagus occupies one segment only.

The pharyngeal, oesophageal, and septal glands. The pharynx, and part of the oesophagus, are, except in the *Chaetogastrinae*, more or less surrounded by deeply staining cells, which have been interpreted in different ways. This applies also to the similar-looking septal glands of *Pristina* and *Dero.* The latest investigations were made by STEPHENSON (1917, 1922 a), KEILIN (1921), SZARSKI (1936 b), PREU (1937), and MARCUS (1943). Surveys of the earlier literature are found in their papers.

STEPHENSON in his earlier paper treated only earthworms. He denied that the "chromophil cells" had any glandular function. In 1922, after the appearance of KEILIN's paper, where it was amply shown that these cells, or at least part of them, form a mucous secretion, which is poured into the pharynx, STEPHENSON abandoned his former stand-point, as regards the earthworms, but kept it for the "*Microdrili.*" He also maintains it in his Oligochaete monograph (1930), and so also does STOLTE (1927, 1933—40). According to STEPHENSON the cells on the pharynx and oesophagus have no connection at all with the lumen of the gut, a space often being found in sections between the wall of the gut, and the flattened, inner surface of the cells, though (in 1915 a) he describes and figures *Haemonais laurentii* (= *H. waldvogeli*) with pharyngeal gland cells, connected with the epithelium. He also denies that the septal glands of *Pristina* have any connection with the gut. He ascribes a function of internal secretion to the "chromophil" cells.

SZARSKI (1936 b, p. 393) fully agrees with STEPHENSON as to the appearance of the cells; he finds no connection with the pharyngeal lumen either. Yet he is of opinion that there must nevertheless be one, the cells in question probably secreting the mucus found in the pharynx.

PREU (1937) distinguishes two sorts of cells on the pharynx and oesophagus in *Nais communis*, one sort in IV—VI, which he calls "chromophil pharyngeal glands," and another in II—IV, on the roof of the pharyngeal diverticle. Of the former he saw one cell in a section with a long neck towards the gut (op. cit., Fig. 3 b), this he considers as a proof of the existence of a connection, through which mucus is secreted into the lumen of the pharynx. He admits that it is impossible to judge whether the gland cells themselves reach into the lumen, (as stated by HESSE, 1894), or whether the mucus trickles down through fine intercellular spaces in the pharynx epithelium, as shown by KEILIN for Lumbricids. As to the function of the gland cells in II—IV, PREU does not give any opinion, other than that they must be of glandular nature, according to their structure.

MARCUS (1943, pp. 48—50), gives quite a new view of the "chromophil cells" (corresponding to the anterior pharyngeal cells of PREU) on the pharynx of *Nais* (= *Allonais*) *paraguayensis* (op. cit., Pl. VII, fig. 33), *Dero evelinae* (op. cit., Pl. VII, fig. 31, Pl. VIII, fig. 32), *Aulophorus carteri* (op. cit., Pl. XIII, figs. 58, 59, Pl. XIV, figs. 60, 62), and *Aulophorus furcatus* (op. cit., Pl. XIV, fig. 61), as he states them to be only the peripheral, basophil parts of the eosinophil epithelial cells of the pharynx roof. The secretion of each gland cell would thus flow through the inner part of the cell before being expelled into the lumen.

This concept he has reached by counting the number of nuclei in the cells of the pharynx roof. He states that in the latter three of the above-mentioned species, most of the ciliated cells have no nuclei, only one nucleus being present per 6—13 "ciliated cones." He explains this by suggesting that the missing nuclei lie in the gland cells surrounding the pharynx; thus these cells must each form only a part of a cell, the rest of which consists of a unit in the pharyngeal epithelium. In *Allonais paraguayensis* most of the ciliated cells, or parts of cells, had "retained their nuclei," as had the gland cells, or parts. Yet he maintains his stand-point about the entity of the ciliated eosinophil-basophil gland cell for this case also, as for the whole family, though it seems hard to explain. About the "chromophil pharyngeal glands" of PREU, MARCUS does not mention anything; this sort are not found in *Dero* (cf. p. 19).

I have studied these cells in a number of genera and species (cf. p. 17). Their general distribution and appearance are as follows. On the dorsal diverticulum, between the muscle-strands, there are aggregates of cells with granular contents, and large nuclei with the chromatin scattered evenly and with a small nucleolus. The aggregates are pear-shaped, though the absolute and relative measurements of the different dimensions vary very much. Thus they are relatively most rounded in small species, such as *Nais*, considerably less so in *Stylaria* — cf. DEHORNE (1916, p. 82, Fig. 45 g) who interprets them as ganglionic -- and *Ophidonais*, and extremely high and narrow in *Dero* (Pl. V, fig. 5, Pl. VI, fig. 1, Pl. X, fig. 2, Pl. XV, figs. 1, 2, *phc*). On the dorsal side of the diverticulum they are higher and narrower than on the lateral sides, and they are weaker on the posterior part. The aggregates in *Stylaria*, for instance, may be up to 40 μ high. The cells themselves are about 5—7 μ in diameter in *Stylaria*, and somewhat smaller in *Nais*. They do not stain deeply with iron haematoxylin or muchaematein, though usually much darker with the latter than the pharyngeal epithelium, but the granules are stained dark-blue by Ehrlich's haematoxylin.

The aggregates are seen quite distinctly to communicate with the pharyngeal epithelium, the muscular layers being broken through, and some of the cells of the aggregate with their ends piercing between the cells of the epithelium (same plates, *neph*). Often a nucleus is seen in this part, indicating that a whole cell, or the greater part of one, lies within the epithelium. (Pl. XV, fig. 1 *nph*). I could not say definitely whether all the cells of the aggregate thus pierce the epithelium, for the cell-boundaries are hard to trace, as the cells appear rather indefinite in outline in sections. Often, however, many of the cells show projections towards the epithelium. In a transverse section of a *Stylaria lacustris*, for example, there are seen in the basal part of the epithelium, between the epithelial cells, a large number of nuclei surrounded by a little cytoplasm. Those nuclei can be clearly recognized as belonging to the gland-cells mentioned above. They are large and roundish and are situated more basally than the epithelial nuclei which are considerably smaller, and oval (Pl. X, fig. 2 *nph*, *nec*). I have not been able to trace with certainty these cells or cell-projections as far as the surface in the larger part of the pharynx. I have tried to trace mucin ducts by staining with muchaematein after fixation in Bouin's or Zenker's fluids (cf. Keilin, 1921), but without any result. I think, that there are no mucin ducts, but that the cells themselves reach the surface and pour out their secretion directly into the pharyngeal lumen. This view is confirmed by the fact that in the posterior part of the pharynx, at the transition into the oesophagus, where the epithelium is considerably lower, the gland cells are plainly seen to reach the lumen.

As to Marcus' conception (p. 15) I could not form a definite opinion, not having had access to a corresponding material (my sections of *Aulophorus furcatus* did not allow of any detailed studies of the pharynx), but for *Dero digitata*, at least, it does not hold. The cells of the pharyngeal epithelium all have nuclei of their own, and thus cannot be assumed to constitute only parts of the gland cells. These nuclei, however, are much more difficult to see than those of the gland cells, being considerably smaller and more weakly staining; possibly they may be even more so in the species examined by Marcus, and the majority of them may have been overlooked by him.

Often the cell-aggregates are seen to contain a varying number of roundish drops or concrements, and these are found in the epithelium also, either in a basal cell, or, as it would appear, between the cells, apparently on their way to the lumen. This is especially clearly seen in Pl. V, fig. 5, of an *Ophidonais serpentina* fixed in formol, and stained with Heidenhain's iron haematoxylin and picro-fuchsin. Here the nuclei are stained dark-blue, and the drops in question almost black by the iron haematoxylin. In places such a drop can be seen to be just on the verge of passing into the lumen, or lying between the cilia, the outer ends of which are plastered together and also stained blue. In the lumen itself they are only rarely found. By muchaematein these drops are stained blue, though not very darkly, to about the colour of the cells themselves. It would seem that they are the mucous secretion of the "chromophil cells," for that the cells are real gland-cells, pouring their secretion into the lumen, seems to me undeniable. There is one objection to this view of the drops, namely that numbers of them are found in the wall of the oesophagus, behind the gland-cells. At least they stain quite similarly with iron haematoxylin, which does not, of course, exclude the fact that they may be something different. In the oesophagus I have never found them on the verge of penetrating into the lumen, but always more basally, which points to a difference.

The cells described above correspond to the anterior sort of PREU, and to those described by MARCUS. There is also the posterior sort of PREU, which corresponds to that described by STEPHENSON (1922 a). These appear as follows.

Some way behind the beginning of the pharyngeal gland-cells described above, e. g. in *Nais* in the third segment, aggregates of larger cells of a different appearance begin to cluster outside them. They stain considerably darker than the previous sort, both with Ehrlich's haematoxylin (Pl. VI, fig. 1) and muchaematein (Pl. VII, fig. 1), but with iron haematoxylin they stain sometimes even lighter (Pl. X, fig. 2). Their cytoplasm stains very unevenly, with dark spots, but no granules can be seen. The nucleus has a large nucleolus with a clear space round it, which is especially conspicuous in *Stylaria* (Pl. X, fig. 2 *noe*). The largest diameter is 11—20 μ. The amount of this sort of cells varies much, e. g. in *Nais communis* they are more sparsely scattered in the third segment, but on the oesophagus they form a dense layer which breaks up in the fifth segment. In the sixth segment where the chloragogen cells begin, they cluster into two heaps on the lower sides of the oesophagus, with which there is only a weak connection. In *Nais elinguis* the heaps are very large, filling the whole lower part of the segment and fitting tightly to septum 6/7, thus closely resembling septal glands. In *Nais variabilis*, and *simplex* too, I have found these cells in VI; in all other species with these gland cells, investigated by me (i. e. all other *Nais*, *Ophidonais*, *Uncinais*, *Specaria*, *Stylaria*, *Ripistes*, *Vejdovskyella comata*, *Slavina appendiculata*, and *Piguetiella*), they cease in V. In *Stylaria* the cells cluster in large heaps round the last of the mucin gland-cells; they then form a coat two layers high round the last part of the pharynx and the oesophagus in V.

This type of cell, which I call oesophageal gland-cells to distinguish them from the purely pharyngeal gland-cells, as they occur mainly on the oesophagus, are obviously those described by STEPHENSON in *Nais communis* and *simplex*, and *Stylaria*. He has apparently not realized that there are two sorts, and has described and figured mainly the oesophageal cells, though it appears that he has mixed them up a little. Thus, his Figs. 10 and 12 show quite plainly the oesophageal gland-cells, though the uneven staining of the cytoplasm in *Stylaria*, mentioned in the text, does not appear in the figure. In the figure only very few of the nuclei show a clear space around the nucleolus, and in the text, too, only a number of them are stated to show this feature. I think this is accounted for by STEPHENSON having looked at both sorts at the same time. The same applies to his statement that the "chromophil cells" of the two species of *Nais* have a granular cytoplasm and no clear space in the nucleus.

It is very difficult to reveal the connections between the oesophageal gland-cells and the lumen of the alimentary canal, but in good preparations I have succeeded in finding places where the inner end of such a cell penetrates into the epithelial layer, and I cannot doubt that there is normally a connection. STEPHENSON lays stress on their often being flat against the wall of the alimentary canal, free spaces often separating them from it. This is true of not quite successful preparations, and formalin is not always favourable. In a Zenker preparation of a *Nais communis*, e. g., the necks are seen plainly (Pl. VII, fig. 1 *neoe*), and in Pl. VI, fig. 1 of an *Ophidonais* they are seen to be extremely long and narrow. As to the heaps of cells clustering outside the pharyngeal cells on the dorsal diverticulum, as well as those in the sixth segment of *Nais communis* and others, I have not been able to find any direct connection with the lumen of the alimentary canal; this does, of course, not exclude the possibility that there may be some connection or other. However, it is easy to understand that STEPHENSON, if looking more carefully at only the oesophageal glands, did not find any connection with the pharyngeal or oesophageal lumen and was led to deny its existence altogether.

As to the function of the oesophageal glands I can say nothing, except that they probably secrete something which is poured into the lumen of the alimentary canal. This secretion ought to be mucin according to the deep staining with basophil dyes, but owing to the contents being non-granular and the evidence given that the different-looking pharyngeal glands have this function, I doubt it. They do not contain the deeply-staining "drops." They may possibly correspond to the "septal glands" found by KEILIN in Lumbricids. These resembled the mucin cells but did not contain any mucin, and were found partly in connection with the pharyngeal gland-cells, partly surrounding the oesophagus. Their connection with the lumen of the alimentary canal was very difficult, and usually impossible to trace, but KEILIN is convinced that it exists. With a view to previous work by WILLEM and MINNE (see KEILIN, 1921, p. 52) on digestive enzymes in earthworms, he considers it very probable that the function of these "septal" gland-cells is the secretion of a proteolytic enzyme.

As to the septal glands of the *Naididae* they are known to occur in *Pristina*, in most of the *Dero s. lat.*, and in *Paranais*. In all these, oesophageal gland-cells are absent. The shape of the septal glands varies rather considerably between different genera. STEPHENSON's description of the glands in *Pristina* is very adequate: the cytoplasm of the cells stains deeply but unevenly with basophil dyes, the nucleus has a large nucleolus and the chromatin granules are scattered peripherally, thus producing a clear space round the former. The cells therefore look very much like the oesophageal gland-cells described above. The septal glands are, however, situated still farther away than these from the alimentary canal, and STEPHENSON denies every possibility of a connection. In species stained *intra vitam* with neutral red, however, I have seen the septal glands connected with the oesophagus by very thin strands running forwards from their lower ends, though I could of course not determine whether they contained any secretion, or were merely strands of connetive tissue. MARCUS (1943, p. 121, Pl. XXII, fig. 93, Pl. XXIII, fig. 94 D, Pl. XXIV, fig. 95 D) saw each septal gland connected with the pharynx by a strand, forming a canal for the secretion.

In *Dero* the septal glands are in much closer contact with the alimentary canal. The first pair in the foremost part resemble in frontal section the usual oesophageal glands, clustered round the pharynx outside the pharyngeal gland-cells (Pl. XV, fig. 1 *sgc*). The lower ends of the glands are in close connection with the lower parts of the pharyngeal wall. The second and third pair (in *Dero digitata*) are packed closely round the oesophagus. Thus there is every possibility of a connection with the lumen, though I have not been able to show with certainty that any such actually exist. — MARCUS (1943) denies that there is any.

In *Paranais* there is only one pair of septal glands, often filling IV. In one of the three species of this genus I have described in the special section (p. 88) the septal glands are closely packed against the oesophagus, in the two other species less so, but yet quite sufficiently to allow of connections.

As is shown above, septal glands occur only in forms lacking oesophageal glands. Sometimes it is not easy to decide to which sort the glands of a given species are to be referred. There are three features generally separating the two sorts, namely the connection of the septal glands with the septa, their character of being paired, and the fact that they are usually closely interwoven with blood-vessels. But the septal glands of e. g. *Paranais litoralis* and *P. friči*, which are fairly free from blood-vessels, are very similar in type to the laterally clustered, oesophageal glands in VI of several species of *Nais*. The glands described by STEPHENSON (1931 a) in *Nais malayana* (= *Allodero m.*) seem to be somehow intermediate, not being situated directly on the oesophagus, but not in contact with the septa either. As I have shown above, the septal gland cells fully resemble the oesophageal ones; sometimes they seem only still more unevenly stained. If all these facts are taken together, I think it will not be rash to conclude that the septal glands are probably oesophageal glands which have lost most of their immediate connection with the oesophagus, though retaining it in places. (Cf. HESSE, 1894, who briefly reported long-necked gland cells in III, communicating with the lumen, in *Stylaria* and a *Nais*, and held these cells to be homologous with the septal glands.)

Contrary to HESSE (1894) and to KEILIN, STEPHENSON (1922 a) is of the opinion that the "chromophil cells" are not epithelial in origin (derived from the pharyngeal or oesophageal wall) but that they are formed by the peritoneum. He points out that they are not surrounded by a peritoneal investment, that the cells often seem to disintegrate peripherally, and that the septa are absent in those places where they are touched by the septal glands, the latter replacing them. As to the first point, the separate aggregations of pharyngeal gland-cells, and the septal glands are seen in good preparations to be surrounded by the peritoneum (Pl. XV, fig. 1 *pe*), and though the peritoneal investment round the oesophageal cells or aggregations of cells is frequently interrupted, it cannot be said to be absent. Regarding the second point, it is quite correct in sections, but in living material e. g. of a *Nais* stained *intra vitam*, the oesophageal cells are seen to form a neat, closely-packed layer of cells with very distinct outlines, not disintegrating at all. As to the septa, I have found them fairly distinct in connection with the septal glands too. In *Dero*, the septal glands of one segment are continuous with those of the following segment at a point about the middle of their height, and here the septa are of course interrupted, but otherwise they appear quite distinct. STEPHENSON investigated members of other families, too, and these I have not examined. Neither have I made any studies on the development of the glands in the budding-zones, as he did. The conditions in the full-grown Naids do not, however, seem to confirm his opinion.

The stomach. There has been a considerable variety of opinions in the literature as to the occurrence of a stomachal dilatation in the *Naididae*, its histological appearance, and functions. VEJDOVSKY (1884, p. 107) considers the "magenartige Erweiterung" as a part of the oesophagus with an unknown function. He does not ascribe to it digestive properties, because it never contains any food. He supposes it to be absent in *Dero*, because PERRIER did not describe one, and in *Ophidonais* he himself could not find one. In the first dilatation of the alimentary canal in *Chaetogaster*, however, VEJDOVSKY sees "vom physiologischen Standtpunkte" a part of the intestine, as food is often present here in large quantities. BEDDARD (1895, p. 305) speaks of "the series of dilatations of the oesophagus" in *Chaetogaster*. "They, no doubt, correspond to the 'magen-ähnliche' dilatation in many Naids."

DEHORNE (1916, pp. 61—62, 83, Pl. II, figs. 15, 16) is the first to give a detailed, though somewhat erroneous, description of the "intestin moyen" in *Stylaria lacustris* and *Chaetogaster diaphanus*. She considers it to belong to the oesophagus and supposes it to be a "chambre branchiale," absorbing the oxygen of the swallowed water. She comes to this opinion because of the rich vascularization of the walls, and the peculiar appearance of the cells, especially in *Stylaria*, where she describes them as provided with numerous short cilia and containing meandriform canalicules. They do not resemble the cells of the intestine, "intestin posterieur," which she does not consider as respiratory. YOSHIZAWA (1928) described the stomachal epithelium of *Stylaria* "*lacustris*" (= *St. fossularis*) as "nearly syncytial" with indistinct cell-boundaries. STEPHENSON (1930, p. 115) states: "In many of the *Naididae* there is, succeeding the oesophagus, a dilatation occupying about a segment at the beginning of the intestinal region. This is sometimes called the stomach; but, except in *Pristina*, . . . its structure does not seem to differ from that of the intestine." The last statement is somewhat peculiar considering that he cites DEHORNE some lines below. MICHAELSEN (1928, p. 31), like the rest of the previous authors, regards the stomach as belonging to the oesophagus, as does SZARSKI (1936 b, p. 391), on account of the epithelium of the alimentary canal in the two segments succeeding the stomach being similar to that of the oesophagus.

SZARSKI gives a detailed description of the epithelium of the stomach and the intestine in *Nais communis*. The former he describes as being provided with vibratile cilia, the cells staining strongly with eosin, especially a layer of minute granules immediately under the surface. He points out the fact that there are distinct cell-partitions in the whole of the alimentary canal; the wall of the stomach and the intestine is thus no syncytium, contrary to the statement of STOLTE (1927 and 1933—1940, p. 335). He has also investigated the alimentary canal with intravital staining and interpreted the results as to the function of the cells (see pp. 24, 25, 29).

STOLTE (1933—1940) calls the stomach "Muskelmagen" though he is not convinced that it corresponds to the gizzard of the terricoles. He deals with it under the heading "Der Ösophagus." About the epithelium he remarks only: "Die Struktur des Magenepithels der Naididen soll übrigens die des verdauenden Abschnittes sein, mit Ausnahme von *Pristina* —," rather ambiguously, as he regards the intestinal epithelium as a syncytium. The stomach of *Pristina* he refers on p. 317 to the oesophagus, on p. 335 to the intestine, and that of *Chaetogaster* is referred to the intestine.

I have found a stomach (cf. below) in all species I have examined, in *Dero* and *Ophidonais*, too, where formerly it has been usually considered to be absent (cf. VEJDOVSKY, 1884; SZARSKI, 1936 b). It is stated to be absent or is not mentioned in the descriptions of several species I have not investigated: all species of *Homochaeta*, *Haemonais*, *Allonais*, and *Branchiodrilus*, and most species of *Aulophorus*. MICHAELSEN (1903 b) considered the stomach of *Uncinais uncinata* to be only a part of the intestine, which is not true. I consider it extremely probable that all Naids really possess a differentiated stomach, though it may not always be marked off by a dilatation.

As shown by the work of most authors who mention the subject, from VEJDOVSKY to SZARSKI, there are essentially three types of stomach in the *Naididae*: the common form, present in most genera, the form in *Pristina*, and that in *Chaetogaster*. To these must be added the form found in *Paranais litoralis*.

In the first type which may be called the *Nais* type, the situation and extension of the stomach varies considerably. It usually begins in VII or VIII and occupies the better part of two segments; in *Ophidonais*, *Dero s. str.*, and *Aulophorus* it occupies, as far as I have found and the literature states, 2 or 3 segments, beginning in VIII, IX, or occasionally X, the actual place varying also within the species. STOLTE (1933—40, p. 316) states: "Bei den Naididen liegt der Muskelmagen im 8. oder 9. Segment, da er bei der Bewegung des Tieres die Lage wechselt." This shifting, of course, only occurs with regard to the exterior segmentation, for the stomach retains its place within the given metamers, marked off by the septa.

Histologically, the stomach is well distinguished from the other parts of the alimentary canal. Its most marked characteristic is a strong brush border, which is always present besides the ordinary ciliary investment. This brush border is usually visible (see Pl. VII, fig. 2, Pl. VIII, fig. 6, Pl. XVI, fig. 1 *bb*), even in bad preparations. It does not seem to have been recorded by previous authors. Possibly, it may be represented by the short, dense ciliation in DEHORNE's Pl. II, fig. 15.

The walls of the stomach are usually thicker than those of the oesophagus and intestine, and the cells therefore larger, especially ventrally. The cell-borders are clearly seen in good preparations (e. g. Pl. VII, fig. 2, Pl. XVI, fig. 1 *cb*), in agreement with SZARSKI's statement. The cells of the stomach have a granular cytoplasm, which often appears striated basally (Pl. XVI, fig. 1). When stained with iron haematoxylin the cells of the oesophagus appear fairly homogeneous and densely blue, whereas the cells of the stomach stain more conspicuously only in the part that lies between the nucleus and the lumen of the stomach. More basally the cytoplasm stains more faintly. (Pl. VII, fig. 2, Pl. VIII, fig. 6, Pl. XVI, fig. 1). In the cells of the intestine only a very narrow layer immediately below the surface is stained (cf. p. 32).

When stained with Ehrlich's haematoxylin and eosin the cells of the stomach and intestine are slightly redder towards the surface than basally. I think this phenomenon must account for the thin layer of eosinophil granules found by SZARSKI immediately under the surface of the stomachal cells, and interpreted by him as the acid secretion of the stomach (op. cit., p. 391). This seems fairly reasonable in itself, but as the same granules, or at least, granules in the same parts of the cells of the stomach *and* intestine also stain heavily with iron haematoxylin, it does not seem quite so simple. In some cells, large roundish black-staining drops or concrements are found, resembling those found in the pharynx and oesophagus (Pl. XVI, fig. 1 *co*). I have not found anything like the "canaux méandriformes" described by DEHORNE in *Stylaria*; probably they were some kind of artefacts.

As pointed out by Piguet (1906), the cells of the anterior wall of the stomach, round the opening of the oesophagus, are extremely elongated in *Nais pardalis*, the inner parts of them pointing far into the lumen of the stomach (Pl. VIII, fig. 6 *pc*). The brush border is absent from this part of the stomach. As to the significance of these cells nothing is known. MARCUS (1943, p. 32, Pl. IV, figs. 17, 18) states that a canal is present in these cells, but in my preparations I did not find one. M. erroneously remarks that such cells were not found in European specimens.

The nuclei of the stomachal cells are roundish, and lie about the middle of the cells, or if these are long, nearer to the surface. They usually stain less strongly than the oval nuclei of the oesophageal cells.

SZARSKI (1936 b, p. 391) states that the alimentary canal (in *Nais communis*) in the two segments following the stomach has an epithelium similar to that of the oesophagus, but I always found the stomach to pass, with or without a constriction, directly into the intestine.

A stomach of the *Nais* type is found in all forms investigated by me, except those mentioned below.

As mentioned above, the stomach in *Paranais litoralis* differs considerably from the *Nais* type (cf. p. 85). Here no brush border is present, only ordinary cilia, and the cells, at least a number of them, contain short and straight, ciliated canals (Pl. III, fig. 1 *ic*). The surface layer of the epithelial cells stains more strongly than the rest. The nuclei are basal. Owing to the fixation not being very favourable for the study of histological details, I have not made any close study of this type of stomach.

Szarski (1936 b) investigated the physiological conditions of the stomach, chiefly of *Nais communis* by intravital staining, and by feeding the worms with albumen, stained with Congo red. In the last case the dye assumed a blue tint while lying in the stomach, indicating that the reaction there is acid. On intravital staining with neutral red he found a thin layer of vacuoles under the surface of the cells stained deep purple. He interpreted these vacuoles as being identical with the eosinophil granules found in sections (cf. above, p. 23). He thought that they contained the acid secretion of the cells. Nirenstein (1922, p. 65) remarks that he found "free acid" also in Naids other than *Chaetogaster* (cf. p. 29).

I have worked with intravital staining, too, but my findings do not quite agree with Szarski's. When a *Nais* (I used *N. variabilis* and *communis*) is placed in the dye (0.01 % solution of neutral red), a faint, diffuse blueish-red coloration appears after a while in the stomachal lumen along the wall. Shortly afterwards a layer of minute, violet drops appears on the wall, not within the cells, as Szarski states, but outside them, closely adhering to the surface. Thus they cannot be simply identical with the granules in the cells. Soon the whole lumen of the stomach is diffusely stained, the drops assemble in the outer surface of the brush border, and another layer of drops appears at the surface of the cells (Fig. 2 *A*, p. 27). All the drops are at first very fine, but eventually they cluster together in somewhat larger heaps, slide out between the long cilia into the lumen, and are swept backwards by the ciliary action into the intestine, where they may be found several segments back, clustering round the food. During these processes the colour deepens considerably, even if the worm is transferred into pure water, until it assumes a deep purple or dark-blue tint. The wall itself is either not stained at all, or at the most only a faint pink, after a long time in the dye.

In some of the animals, purple drops are found in the oesophagus, too, either in its whole length (*Nais communis*), or in the hind part (*N. variabilis*). Szarski stained also *Dero* "*communis*" (= *D. obtusa*) and found here only a minute ring round the opening of the oesophagus into the intestine that took colour. He assumed this to correspond to the stomach of other *Naididae*. I made the same experiment with *D. digitata*, and here a strong, dark-red coloration of the lumen of the stomach appeared, and minute purple drops were secreted from the walls. The staining process in this species, however, took much longer time than in *Nais*, about 20 minutes. I also carried out some experiments with *Ophidonais serpentina*, *Vejdovskyella*, *comata* and *Slavina appendiculata*, and there was always a purple, or dark-red staining of the stomachal lumen, and sometimes, though not always, purple drops were seen. The material was, however, too scanty to allow of generalizations of the differences.

The neutral red solution employed seems to be poisonous to the Naids, for after some time the secretion from the stomachal cells ceases, even if the worms are restored into water, and the animals die within a few hours. Only very faintly stained specimens may recover, if restored into water, with food.

The third type of stomach is that present in *Pristina*. It had already been noticed by VEJDOVSKY (1884, p. 107) that the stomach of *Pristina longiseta* showed a peculiar appearance: "Die Magenartige Erweiterung von *Pristina longiseta*, welche vorn stärker angeschwollen ist und somit eine herzförmige Gestalt annimmt (Taf. II. Fig. 13. K.) weist darauf hin, dass das in Rede stehende Organ von drüsiger Beschaffenheit ist, indem die inneren Epithelzellen sich in dem vorderen Theile zu eigenthümlichen mit einem glänzenden homogenen Inhalte gefüllten Drüsenzellen modificieren (Taf. II. Fig. 14)." GARBINI (1898, p. 563, Fig. 1 b) noted, in the stomach of his *Pristina affinis* (= *Pr. aequiseta*?), "particolare cellule epiteliali squamoidi che rassomigliano a tante piastrine", and PIGUET (1909, p. 213) remarks that *Pristina aequiseta* shows the same feature, and that the stomach always occupies VIII.

MICHAELSEN (1913, p. 211) was the first to realize that the cells in question contained canals. "Die grossen Zellen des hier etwas gefältelten Epithels zeigen deutliche Kanal-artige Durchbohrungen, Einrichtungen, wie ich sie zuerst bei verschiedenen Enchyträiden nachgewiesen habe, und die ich als Chylusgefässe ansprach. Dieses Magen-ähnliche Organ ist also als Chylusmagen zu bezeichnen." AIYER (1930, p. 23) speaks of "narrow, branching ducts" in the cells of the stomach of "*Naidium*" *menoni*. STEPHENSON in 1930 only mentions that the cells in several species have an intracellular lumen. Later (1931 c, p. 301) in the description of *Pr. macrochaeta*, he writes: "Sections show that the epithelial cells of the stomach lining possess each an intracellular canal opening into the lumen —." STOLTE (1933—40) also briefly mentions these intracellular canals.

SZARSKI (1936 b) has also examined the stomach of *Pristina*. He has studied it in sections and by intravital staining. He arrives at the conclusion that the canals (which are not found in all cells) are not such, but long vacuoles containing an acid secretion. He finds various stages in the secretory process, illustrated in his Pl. XVIII, figs. 18—23, only one stage at a time in the same animal, the whole protoplasm being stained only in some, starving, animals. He interprets his results as follows: during a period of hunger, the secretion is accumulated in the cells, first permeating the whole cells, then accumulating into larger and larger vacuoles. When it has flown together into one large vacuole in each secretory cell, the animal begins to swallow food, using part of the secretion for each portion of food, till the store is exhausted, and it enters a new period of hunger.

MARCUS (1943, p. 122) studied the stomach in *Pristina longiseta* and *americana.* He recognizes the canals as such, and in accordance with a figure of *Pr. americana* showing some granular matter leaving the canals (op. cit., Pl. XXIV, fig. 98 b) he concludes that their function is secretory. He states that the cytoplasm round the canals is hyaline, consisting of "bastonetes minusculos, pouco numerosos" (cf. op. cit., Pl. XXIII, figs. 96, 97). He also states that in *Pr. longiseta* at least, the canals are not all intra-cellular, some of them being surrounded not by a single cell, but by a block of 2 or 3 coalesced cells, which is shown by the presence of this number of nuclei in the cytoplasm.

I have studied the stomach of several species of *Pristina* (before seeing MARCUS' paper), both in sections (all the species I have examined) and by means of intra-vital staining (*Pr. longiseta*, *foreli*, and *amphibiotica*). Already in sections one sees quite clearly that the wall of the stomach consists of very high, granular cells, each containing a canal, the walls of which are provided with a brush border, like the whole inner surface of the stomach and the last part of the oesophagus. In *Pr. longiseta* the canals are extremely long and curved at their basal end (Fig. 2 *B*), in the other species they are shorter (Pl. XIX, fig. 2, Pl. XXI, fig. 1). The free surface of the stomachal cells, and the outer parts of the canals, also possess an ordinary ciliary investment. As MICHAELSEN remarked, these cells are remarkably similar to the "chyle-cells" in the intestine of the Enchytraeid genus *Fridericia* (cf. STOLTE, 1933—40, p. 338, Fig. 297). It is possible that a few cells, or cell blocks, possess more than one nucleus.

On staining *intra vitam* with neutral red, only a faint, diffuse purple colour in the stomachal lumen and the canals is at first observed. The latter at this stage look like the "vacuoles" in SZARSKI's fig. 18. After some seconds, minute round or rod-like drops appear in the brush border of the canals. They are then, one after another, at longer or shorter intervals, pushed out into the lumen of the canal. Here they accumulate, first into larger drops, or ribbon-like formations (Fig. 2 *B*, *E*), which finally flow together in the middle of the canal lumen (Fig. 2 *B*, *C*, *D* and Pl. XXI, fig. 2). (These pictures quite resemble SZARSKI's figs. 19—23, where the whole cells correspond in fact only to the proximal parts of the canals, the larger vacuoles in the middle indicate the assemblages of secretion in the lumen, and the smaller ones the small drops still lying in the brush border.) When the basal part of a canal is filled with secretion, so that the outer end of this comes into touch with the cilia of the distal part of the canal, the whole ribbon is swept away by the ciliary action and brought into the

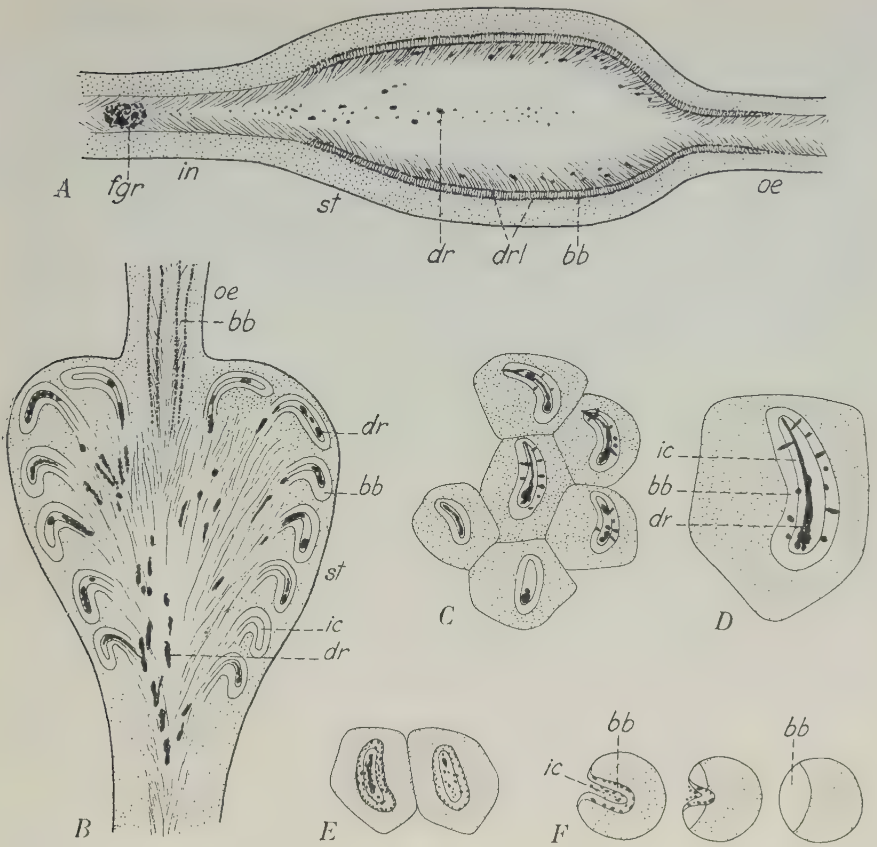

Fig. 2. Intra-vital staining of the stomach. *A Nais communis*, *B–F Pristina longiseta*. *B* stomach, showing the whole length of the intra-cellular canals, *C* some cells viewed from the outer surface, with the proximal ends of the canals, *D* a cell at greater magnification, *E* cells with formation of round drops only, *F* a liberated cell, the canal turning inside out. *bb* brush border, *dr* stained drop, *drl* layer of stained drops, *fgr* food in the intestine, with stained drops clustering round it, *ic* intracellular canal, *in* intestine, *oe* oesophagus, *st* stomach.

intestine (Fig. 2 *B*). This picture of the process is adequate for *Pr. longiseta* and *foreli*; in *Pr. amphibiotica* there is no accumulation of the secretion into ribbons. There are only minute round drops, which are swept out in a flow into the stomachal lumen. (Pl. XIX, fig. 2). In starving animals no secretion seems to occur, for there is only a diffuse staining of the lumen of the canals giving fig. 18 of SZARSKI, which he found only in starving specimens. Otherwise I have found all his stages in the same animal, though usually not the extremes at the same time.

Thus, I can neither confirm SZARSKI's statement of the strict synchronism of the cells, nor of the periodical formation of the secretion during hunger. In newly-captured animals I always found the intestine to contain food; no voluntary starving seems to occur. As to the interpretation of the phenomena cf. p. 30.

As Szarski points out, the last part of the oesophagus also stains purple.

It seems (cf. Szarski, p. 398) that the dye poisons the cells, for on using 0.01 % solution the formation of the drops very soon ceases, and no new drops are seen in the brush border. The animals die rather soon. On applying a 0.001 % solution the staining is slower, but if the animals have food most of them are still alive after a day, and secretion is still at work. The ciliary action, however, has ceased, so that the canals, the stomachal lumen and the hindmost part of the oesophagus are crammed with heaps of secretion. If the animals are restored into water, the ciliary action commences again, and the secretion is swept away, but the animals usually die within some hours.

In one specimen, which I observed under a coverglass, the body wall ruptured beside the stomach, and the latter flowed out through the hole. The cells loosened from each other and immediately rounded themselves off. The canals were turned inside out, and could be recognized only by light spots on the surface, obviously representing the brush border (Fig. 2 *E*). The colour immediately disappeared on contact with the water.

As the stomach in most species always lies in VIII (on aberrations caused by irregularities in the budding process see Hempelmann, 1923, p. 432), it must be differentiated from the old intestine on budding. I have never observed any changes in the intestinal epithelium in zooids not yet parted from the chain. In one specimen, obviously quite recently separated, however, though the stomach was not yet exteriorly differentiated from the intestine, the specific stomachal cells were already formed. No staining occurred, though the intestine contained much food. It seems that the differentiation of the stomach takes place at just about the time of the separation of the bud.

The fourth type of stomach is the one present in *Chaetogaster* and in *Amphichaeta*. Already Vejdovsky had remarked that in *Chaetogaster* it was distinguished from the stomachal dilatation of the other Naids in so far as the food remains there for a considerable time. Also, it is much more conspicuous than the stomach of most other genera, being very wide, with narrow in- and outlets. It is restricted to V—VII in *Ch. diaphanus*, V—VI in the smaller species. The epithelium of the stomach has been described by Dehorne (1916), Nirenstein (1922), and Szarski (1936 a). The cells are low, hexagonal, and provided with long cilia, which are immobile except in the last part of the stomach.

In my sections the cytoplasm appears homogenous, but the cells contain a layer of non-staining vacuoles, containing numbers of colourless or faintly yellowish, refractive granules (Pl. I, figs. 6, 7 *grl*). (These vacuoles and granules probably correspond to the granules figured by SZARSKI, 1936 a, Pl. IV, fig. 1, though he has drawn them immediately inside the free surface of the cells.) The vacuoles are easily seen in living animals, too. They are round, yellowish and densely accumulated in the cells, except round the nucleus and along the cell borders; their position is most conveniently studied in specimens stained *intra vitam* (Fig. 3 *A va*). They are easily confused with the chloragogen, which is very similar in appearance, but as this is situated outside the stomach, the two sorts can be distinguished by focussing up and down with the microscope.

NIRENSTEIN found only very few, small vacuoles with granules. DEHORNE states that there are found in "l'intestin" (which name seems to include both stomach and intestine) globules staining like chloragosomes, but her pictures do not show any (op. cit., Figs. 20, 22, 23). STEPHENSON (1911, 1918) states that some of the cells in the crop of *Ch. spongillae* (= *Ch. langi*) and *Ch. bengalensis* (= *Ch. limnaei bengalensis*) are higher than the rest, projecting into the lumen in an amoeboid manner, suggestive of intra-cellular digestion, as in a Hydra. In *Ch. cristallinus* I found the same phenomenon (Pl. II, fig. 3), but I doubt S.'s interpretation.

The stomachal epithelium of *Amphichaeta* agrees with that of *Chaetogaster* (Pl. II, fig. 4).

Various authors, mainly PRZESMYCKI (1897), SIMM (1913), NIRENSTEIN (1922), and SZARSKI (1936 a, b), have studied the stomach by feeding *Chaetogaster* with food mixed with various dyes, such as Congo red and Sudan III, and by intra-vital staining, *inter alies* with neutral red. They have shown the stomachal contents to have an acid reaction. PRZESMYCKI also found a net-work of violet granules along the cell-borders of the stomach in *Ch. diastrophus*, when using neutral red. SIMM confirmed this observation, but stated it to hold only for this species. This is, however, not correct, as NIRENSTEIN observed the phenomenon in *Ch. diaphanus*, and I found it in *Ch. limnaei* (see below). NIRENSTEIN explains the granules as being neutral-red-laden granules of the cytoplasm, which are expelled and accumulate in the intercellular spaces. This he states to be a common phenomenon in cells with a free surface. SZARSKI (1936 b, Pl. XVIII, fig. 12) found red-staining vacuoles in the enlarged cells of the anterior wall of the stomach in *Ch. diastrophus*. He assumes them to contain some secretion of the cells.

I have made some experiments with intra-vital staining with neutral red, chiefly using *Ch. limnaei*. This species is somewhat less favourable than the others, being the most opaque one, but it is most easily obtained in winter (living in snails, which are easily kept in aquaria), and if the worms are starved for a couple of days, they become sufficiently transparent.

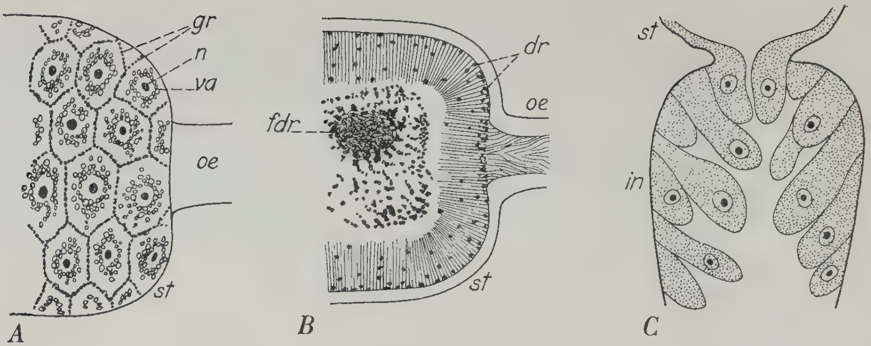

Fig. 3. *A*, *B* *Chaetogaster limnaei.* Anterior part of stomach, stained *intra vitam*. *A* surface view, *B* optical section. *C* *Chaetogaster diastrophus.* Intestine with cells projecting into the lumen. *n* nucleus, *va* vacuole; other legends as in Fig. 2.

When a worm is introduced into the dye (0.01 %) the stomach soon assumes, as stated by previous authors, a diffuse violet colour. In starving specimens there was, as a rule, nothing more to be seen in the lumen. When food was taken, however, (I used Paramaecia) this assumed a strong reddish-violet colour, and in a moment drops of varying size appeared in the ciliary layer of the stomach, at first at the surface of the cells, then by and by sliding out into the stomachal lumen, where they were soon abundant, while more drops appeared among the cilia (Fig. 3 *B*). Heaps of drops clustered round the food. The interior of the drops appeared reddish, the contours purple. (The drops are considerably larger than in other Naids investigated.) When the yellowish vacuoles in the cells of the stomachal epithelium were observed (cf. above), the stained drops in the basal part of the ciliary investment were visible together with them, and might be mistaken for violet- or red-stained vacuoles in the cells, but as far as I was able to ascertain the red-coloured drops always lay outside the cells. I suppose that these drops in the ciliary layer must have been the granules referred to by Szarski, though he saw them only in the foremost part of the stomach. The net-work of violet granules along the cell borders referred to above was visible throughout the observation.

The observations made after staining with neutral red, which have been reported above, are hardly sufficient as bases for a physiological interpretation. However, assuming that the conditions are essentially similar in all the forms examined, the simplest explanation of the phenomena seems to be also the most probable. Thus, the contents of the stomach are probably acid, as maintained by previous authors. The violet-stained drops will represent a secretion of the stomachal epithelium, though the quantity and the character of the secretion are apparently to some extent abnormal during the experiments, owing to the toxic action of the dye.

The intestine. As the histology of the intestine in *Chaetogaster*, and apparently in *Amphichaeta*, is different from that of the other Naids, I shall treat the two types separately.

The common Naid type of intestine has been treated by YOSHIZAWA (1928) in *Stylaria* (very shortly), and by STOLTE (1927) and SZARSKI (1936 b) in *Nais communis*. DEHORNE (1916) states that the structure of the intestine in *Stylaria* is identical with that in *Chaetogaster*, which is not true. STOLTE regards the intestinal epithelium as a syncytium, with scattered "Ersatzzellen". In older parts the epithelium is stated to become lower and "blasig verändert", and to contain chloragosomes; he describes various stages of senescence, the last of which is characterized by a complete disappearance of the structure, an accumulation of phagocytes, and very strongly developed chloragogen. The foremost parts of the intestine are older and are stated to show the most advanced signs of senescence (young worms do not show other than the younger stages), the signs being slighter when one approaches the zone of fission. SZARSKI found in the first part of the intestine slightly eosinophil cells with a vesicular cytoplasm and cilia. In some animals he found granules staining like chloragosomes, which he identifies with the chloragosomes found by STOLTE in ageing parts of the intestine. SZARSKI, however, interprets them as a digestive secretion. In the subsequent part of the intestine he found larger, slightly acidophil cells, and smaller, basophil ones; the latter he considers as undoubtedly secretory. Towards the zone of fission all cells become uniform. In *Pristina* the intestine is stated to have a similar structure.

I have not made any thorough investigation of the intestine, but I made some observations on the material used for other purposes. A striking feature, not recorded by earlier investigators, is the presence of a brush border, like that of the stomach, though much lower, besides the long cilia. (In earthworms parts of the intestine are stated by DEQUAL to have a brush border and cilia; cf. STOLTE, 1933—40, p. 336.) It is, naturally, more easily seen in the larger species, like *Dero* (Pl. XVI, fig. 2 *bb*) or *Ophidonais*, than in *Nais*, and it is not made visible by all fixatives. In the hindmost part, before the anus, it seems to be absent.

It is difficult to get a uniform conception of the structure of the epithelium, for the picture varies with different individuals and species. Thus, there are seen in some specimens a large amount of concrements, or large drops, in the basal parts of the cells (Pl. XVI, fig. 2 *co*), stained more or less dark blue by iron haematoxylin and reddish by eosin, while in other specimens of the same species they may be almost lacking, apparently without any differences in other respects. Generally, it may be said that the cells of the intestine are lower, and more vacuolated than those of the stomach, and that they become more and more so backwards, till immediately in front of the zone of budding. In the foremost part the cytoplasm is distinctly granular, a narrow zone below the free cell-surface staining rather heavily with eosin, and iron haematoxylin (cf. p. 23; Pl. XVI, fig. 2). The basal part is slightly vacuolated. Between these cells there are other, more darkly staining, narrow, and rather irregular cells (Pl. XVI, fig. 2 *ninc*), obviously identical with STOLTE's "Ersatzzellen" (cf. his Fig. 6 f.) and SZARSKI's basophil cells (cf. his Pl. XVIII, fig. 5) though the latter found them farther back. Sometimes I have found in this part a few yellow granules, looking like chloragosomes though not distributed under the surface, as in STOLTE's Fig. 7 c, and SZARSKI's Pl. XVIII, fig. 4, but contained within the vacuoles. Farther back the cells become strongly vacuolated and in the vacuoles are seen dark-blue-staining, irregular cells, apparently representing STOLTE's "Aufräumzellen", giving a picture very much like STOLTE's Fig. 9, though the chloragogen is often very scanty (Pl. XVII, fig. 1). According to him this represents an aged stage, but as it is here characteristic for the part of the intestine preceding the zone of budding, contrary to the findings of STOLTE, it would represent a young one. I am inclined to believe that the different pictures have in themselves nothing to do with senescence, but rather with different functions. In the newly-formed part immediately preceding the budding-zone the epithelium is homogeneous and non-vacuolated.

The above picture of the intestine is upset in sexually mature worms. In Pl. X, fig. 3 of a mature *Stylaria lacustris*, for instance, the cells, the narrow sort too, are seen to be crammed with granules, which are larger than usual, some of them refractive. In wholly mature individuals of *Dero*, on the contrary, the intestine degenerates as pointed out by STEPHENSON. In *Piguetiella* the case is much the same as in *Stylaria*; the granules are partly smaller, filling the cytoplasm, and partly larger, very much resembling chloragosomes, lying in sometimes very large vacoules (Pl. XII, fig. 1 *vach*). In one specimen it is clearly seen that these vacuoles, surrounded by a thin layer of cytoplasm, are discharged into the lumen of the intestine, where they round themselves off (Pl. XII, fig. 1). Later the cytoplasm is evidently dissolved, for scattered heaps of the chloragosome-like granules are also seen in the lumen. This phenomenon is very suggestive of excretion; in fact it is strongly reminiscent of the formation of "Exkretblasen" in the intestine of Myzostomids described by JÄGERSTEN (1940), but in this case the excrement-filled vesicles left the intestine still intact.

On the whole, I found the amount of chloragogen surrounding the intestine to increase during maturity, instead of decrease as stated by YOSHIZAWA (1928, p. 600).

The intestine of *Chaetogaster* has been described by various authors, its histology by DEHORNE, NIRENSTEIN, and SZARSKI (1936 a). At the transition of the stomach into the intestine there is usually a short constriction. The intestine itself is dilated in two or three segments. Then, in budding animals, the budding-zone follows, but in fully sexually mature specimens, in which the budding has ceased, there are a number of segments with a very narrow intestine.

About the histology, DEHORNE (1916) only remarks that the epithelium is higher and more irregular than that of the stomach (op. cit., Fig. 20) and that the cells contain, as in all Naids, globules staining like chloragogen. SZARSKI states that they are provided with long vibratile cilia, and contain a large, though varying, amount of granules. NIRENSTEIN found two sorts of cells: resorption cells with cilia containing granule-filled vacuoles and fat-drops, and gland cells with acidophil granules and basophil plasm. Unfortunately, he gives no figures.

I have also found two sorts (the pictures are most vivid in mature specimens). Most of the cells are cubical or columnar, ciliated, but without a brush border, containing vast amounts of yellowish granules of varying size, staining like chloragosomes, in the cytoplasm or in vacuoles (Pl. I, fig. 5 of a *Ch. diaphanus*). Between these are much fewer cells with a more strongly basophil plasm, containing something resembling a faintly stained secretion (Pl. I, fig. 5 *bc*). Whether NIRENSTEIN is right in his interpretation of the different sorts and the nature of their contents, I could not say. The narrow end part of the intestine in mature worms consists of lower cells with a smaller amount of small, refractive granules. The intestine in *Amphichaeta* seems to completely resemble that in *Chaetogaster*, though the cells are relatively smaller.

In the intestine of the Naids, except *Chaetogaster* (*Amphichaeta?*), there is an upward flow of water from the anus, caused by the ascending action of the cilia (STEPHENSON, 1913 b), and carrying oxygen to the intestinal plexus, which thus has also a respiratory function.

From this treatise of the alimentary canal some conclusions might be drawn as to the mutual relations between the different parts. As remarked above (pp. 20—22) most authors count the stomach ("crop," "Muskelmagen") as a part of the oesophagus. It would seem to me, however, that the structure of the oesophagus is rather different from that of the stomach, the former having a columnar epithelium of narrow, basophil cells with cilia, the latter (except in *Chaetogaster*) an epithelium of larger, less basophil cells with a brush border beside the cilia. (This picture is somewhat obscured in *Pristina*, where the posterior part of the oesophagus has also larger cells and a brush border. This part may perhaps be regarded histologically as a part of the stomach, though it lies in front of the dilatation, and the cells contain no canals.) The intestinal epithelium, on the other hand, consists of cells, partly very similar to those of the stomach, and provided with a brush border. Therefore, it seems to me that the stomach cannot be regarded as a part of the oesophagus, but possibly as belonging to the intestine.

As to the stomach in *Chaetogaster*, though it is not very similar to that of the other Naids, it is probably nevertheless homologous to it. This conclusion perhaps appears less rash, if it is taken into account that the intestine of *Chaetogaster* must be homologous to that of *Nais* etc., in spite of its strongly deviating appearance and histology.

A last part of the intestine representing a rectum is hardly recognizable.

The distribution of the chloragogen. Generally the chloragogen has the same extension as the alimentary plexus (cf. p. 36; STEPHENSON, 1930; STOLTE, 1933—40), in *Chaetogaster* and *Amphichaeta*, too, where it thus begins in V, one segment further forwards than usual. There are, however, exceptions. Thus, in *Pristina*, according to the literature, it occurs from IV, V, or VI onwards (cf. the systematical part). I have always found the chloragogen present as far forwards as IV or V in *Pristina*, though there seems to be no vascular plexus on the oesophagus. In the foremost segmens it is very scanty, and it is present not only on the gut and the dorsal vessel, but in the anteriorly budded segments chloragogen cells are also found fixed to the septa, the setal sacs, and the body wall. In these cells the chloragosomes seem, however, to be of a different composition from those on the gut and dorsal vessel, being considerably larger (3.2—5 μ, against 1—1.5 μ) and green instead of yellowish. In *Haemonais* the chloragogen is also present in the segments formed anteriorly on budding (STEPHENSON, 1915 a; LASTOČKIN, 1924 a; MALEVICH, 1929). According to STEPHENSON it surrounds the gut as far forwards as IV, and is present in large aggregates in the prostomium and I—II. Here, too, the chloragogen of the gut and dorsal vessel seems to differ from the rest, containing less brown pigment. In *Branchiodrilus* there is a stripe of brown pigment in each gill-bearing segment and aggregates in the anterior segments (cf. e.g. STEPHENSON, 1912), the pigment according to STEPHENSON being of the same nature as the chloragogen and enclosed in cells attached to the parieties. S. reports chloragogen on the transverse vessels, too, in this genus. He does not report how far forwards the chloragogen is represented on the gut, but on the dorsal vessel it occurs only as far as between the first and second gills (VI and VII), so presumably it does not here exceed the limits of the alimentary plexus. In *Chaetogaster* the chloragogen is scanty.

Ingestion of food. The general mode of ingestion in the *Naididae* is by protruding the dorsal diverticulum of the pharynx and retracting it with the matter thus obtained. The details of the process are, however, described rather differently by different authors. DEHORNE (1916) describes it in *Stylaria lacustris*, where the pharynx is stated to form, when extruded, a "cornet" (op. cit., p. 81, and Fig. 39). Provided with a "corps gustatif" (cf. p. 12) it would choose among the débris, tearing loose the fixed algae, grinding those present in masses, and retracting itself after every effort. CORI (1928, whose description has been cited by various authors, e. g. STEPHENSON, 1930, and STOLTE, 1933—40, p. 348) is of the opinion that in *Nais*, *Stylaria*, and probably most other Oligochaeta, both the dorsal and the ventral wall of the pharynx are extruded and retracted in such a manner that the food is rolled in as between two rotating cylinders. SZARSKI (1936 b, p. 399) states that only the dorsal wall is protruded, taking back with it particles adhering to the surface. He emphasizes that there is no selection of convenient food, and that the process is very rapid, making observation difficult. MARCUS (1943) gives pictures (op. cit., Pl. XIII, fig. 56) of an *Aulophorus carteri* taking a food-particle with its slightly concave pharynx plate.

I have made observations mainly on *Nais variabilis* and *Dero digitata*. If the food particles lie scattered in the water, the movements of the pharynx are extremely rapid, hardly allowing of observation, but if the animals are made to "graze" on a small twig with affixed algae, or among very densely massed and cohering detritus, the pharynx is often extruded for several seconds at a time, thus allowing a thorough inspection. Large species are, of course, easier to observe than small, and *Dero digitata* afforded a very favourable object. The dorsal diverticulum only was protruded and tore off bits of detritus, as described by DEHORNE, though of course not grinding them. When the animals had difficulties in tearing anything loose, they could be seen tugging at the matter and wrestling with it for several seconds. The protruded part of the pharynx formed an oval trumpet, the lateral parts functioning as lips, keeping hold of the food (Fig. 4). Thus, the food does not only merely adhere to the surface by the mucus, but is also actively taken.

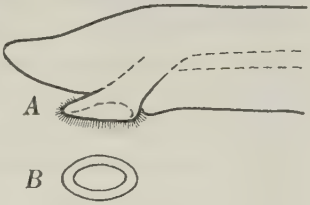

Fig. 4. *Dero digitata*. *A* anterior end with everted pharynx, *B* the latter, viewed from below.

Quite a different mode of nutriton has been recorded in *Ripistes parasita* by CORI (1928) and PESSON (1938). When undisturbed the worm stretches out the foremost part of its body, from its fixed mucous tube, swinging it rhythmically to and fro. Small food particles in the water then adhere to the long, sticky hair setae of VI—VIII, which are licked off at certain intervals by being pulled through the mouth, the setae of each side regularly alternating. (For details see CORI.) When the tubes are fixed to the walls of the aquarium the process is easily studied, and I can confirm CORI's observations in every detail, except that all the setae of the same side were pulled through the mouth at a time, not those of one bundle only, as figured by CORI (op. cit., Fig. 1). Like him I never found *Ripistes* feeding in the common *Nais* manner. I could not make out whether the pharynx is protrusible at all.

In *Chaetogaster* the food is sucked in together with a quantity of water, the pharynx being used as a pipette; the process was described in detail by DEHORNE (1916). (In a *Chaetogaster sp.* ANNANDALE, 1906, describes quite a different method: here the setae of II would be used for seizing and keeping the prey — how this is then swallowed, is not mentioned, cf. p. 64. It is, of course, quite possible that A. was mistaken.) The *Chaetogaster* are often referred to as being exclusive predators; in reality, however, only the large species, as *Ch. diaphanus* and *cristallinus* (and *Ch. limnaei*), feed regulary on prey, whereas the food of the small ones consists of diatoms, detritus, etc., with occasional small rotifers, Stentors, etc.

As pointed out by KALLSTENIUS (1892), *Amphichaeta* feeds in the same manner as *Chaetogaster*, the food consisting of diatoms only.

The vascular system.

The extension of the alimentary plexus. The alimentary plexus (following STEPHENSON I use this word, not "sinus", as it is undoubtedly plexiform, not forming an uninterrupted space around the gut) is usually confined to the parts of the alimentary canal behind the segments formed through budding at the anterior end of the animal, i. e. the intestine, stomach and posterior part of the oesophagus. This means the parts behind septum 5/6 in most forms, and presumably behind septum 4/5 in *Paranais* and *Stephensoniana*, and 7/8 in *Pristina*. Whether it is absent from the stomach in *Pr. amphibiotica* and *idrensis*, where the stomach is in VI—VII, I have not been able to ascertain, owing to the small size of these species, but judging from the close connection of the dorsal vessel with the stomachal wall, it ought to be present. In *Pr. rosea* and *menoni* it is present also on the part of the stomach lying in VII which is formed in the budding-zone. *Chaetogaster* and *Amphichaeta*, too, form exceptions to the rule, as here the plexus is present on the whole of the stomach, though the first part of this, lying within the fifth segment, is formed in the budding-zone.

The extension and appearance of the alimentary plexus are often very hard to observe, as it is obscured by the chloragogen. In *Dero digitata* (especially when stained *intra vitam* with neutral red), however, it is very easily observable. Here, the branches of the plexus are largely free of chloragogen. There are on the intestine, viewed laterally, 7—8 longitudinal ducts on each side, and, crossing these very regularly, about 5—7 transverse ones in each segment. The broadest of the latter is situated in the constriction of the segment border. Thus, a very regular net-work is formed, with parallel meshes, and with only occasional irregularities, as shown by Štolc (1885, Pl. I, fig. 13), and by Perrier (1872, Pl. I, fig. 5) on *Dero obtusa*. — As a rule, however, the plexus seems to be more irregular.

In *Chaetogaster* the regular arrangement of the ducts on the stomach has often been pointed out; it has systematic value (cf. the systematical section). Here, a conspicuously larger, longitudinal duct is formed on the ventral side (cf. Leydig, 1857, pp. 344—345, Fig. 184; Vejdovsky, 1884; Stephenson, 1913 b; Dehorne, 1916), called by Stephenson a "subintestinal vessel". Dehorne claims to have found one in all other Naids, too, but I have not been able to distinguish it in any save *Chaetogaster*.

The plexus is always much swollen and filled with blood in mature specimens.

The situation of the dorsal vessel. The dorsal vessel is free only in the oesophageal and pharyngeal segments, being intimately connected with the alimentary plexus on the stomach and intestine. Stolte (1933—1940) cites the statement of Fuchs (1907) that the dorsal vessel in most genera dissolves into the plexus, being actually present in its posterior part only in a few genera, as *Nais* and *Ophidonais*. This is not so, however, the dorsal vessel always being conspicuous throughout its length. Observation is facilitated by the waves of contraction, and by the fact that the peripheral wall of the vessel is not, or only very sparsely, set with chloragogen, which makes it appear as a yellowish strip against the gut.

As has already been remarked by Vejdovsky (1884; according to Fuchs, 1907, and Stolte, 1933—1940, p. 408, though I have not been able to find the statement), the dorsal vessel in *Dero* for most of its course runs ventrally on the gut, along the left side of the ventral vessel. Stephenson (1911 — this paper deals with *Aulophorus tonkinensis*, not *A. vagus*, as stated by Stolte — 1912, 1913 b, 1915 a, etc.) has pointed out that the same applies to *Aulophorus*, and that in *Haemonais* and *Branchiodrilus* the dorsal vessel also runs along the left side of the gut, though more laterally. He (1930) mentions the fact that all these forms and two Tubificids which possess the same feature show a special respiratory apparatus, though he does not suggest a connection between the two phenomena (cf. also Stolte, 1933—40). Such a connection seems, in fact, improbable, as the dorsal vessel is situated more or less to the left in a number of other species, too. Thus, Aiyer (1926) reported it on the left side in "*Naidium*" *trivandranum* (= *Stephensoniana tr.*) and (1930) in *Nais pectinata* (= *Allonais p.*), Mehra (1920) in *Nais pectinata* var. *inaequalis* (= *Allonais inaequalis*), Černosvitov

(1937 b) in *Pristina americana*, and I have found it ventrally to the left in *Piguetiella* and *Specaria*. Among the other genera and species, I have found it more or less decidedly lateral in all the species of *Nais* I have investigated, except *N. elinguis*, and in *Uncinais* and *Slavina appendiculata*. It appeared exactly mid-dorsal, or only very slightly displaced to the left, in *Nais elinguis*, *Stylaria* (cf. Wolf, 1928), *Ripistes*, *Vejdovskyella comata*, *Ophidonais*, and *Pristina*. Wolf reports it to be mid-dorsal in "*Stylaria brevirostris*" (= *Arcteonais lomondi*). Its position has not been reported in *Vejdovskyella intermedia*, species of *Allonais*, and the tropical species of *Nais* and *Slavina*.

The displacement may possibly have some connection with the swimming habits of the different species. All the swimming *Nais*, except *N. elinguis*, (i. e. *N. variabilis*, *simplex*, *barbata*, *pseudobtusa*, *pardalis*) swim by contracting their body spirally (cf. Piguet, 1906). *Dero digitata* swims in the same fashion (cf. Aiyer, 1930, on *D. zeylanica*). If the spiral is always one-sided (which I have not succeeded in determining), it is easy to understand that the mid-dorsal vessel may have been displaced to a position where it is less exposed to the stretching out and pressing together of the intestinal wall during the movements of the animal. *Nais elinguis*, which has a median dorsal vessel, swims by lateral bendings in the horizontal plane (p. 130; cf. also Piguet, 1906). *Stylaria lacustris* (and *fossularis*, Yoshizawa, 1928), swim lying on one side and moving their anterior and postorior ends in the horizontal plane rapidly towards opposite sides of the middle of the body, making approximately an 8 with the curves dorsoventral, not lateral. (Wolf erroneously states that all the swimming Naids swim in this manner, though with lateral movements.) *Ripistes parasita* makes similar movements, though standing vertically in the water, not lying on one side. In these cases there will be no constant force pressing the vessel in a certain direction (cf. Stephenson, 1913 b, p. 769, who suggests that the median position of the longitudinal vessels results from the lateral bending movements in general). As to the non-swimming species with a dislocated dorsal vessel, they might be supposed to have inherited the character from ancestors swimming in spirals. Those which have kept the vessel dorsal, might be descendants of forms swimming with symmetrical movements, or non-swimmers. *Pristina longiseta* is stated by Berg (1938) to swim "with rapid serpentine movements", but to my knowledge no other author mentioned anything about swimming in *Pristina*. Piguet (1906) never observed swimming in *Pristina*, nor have I in any of the species. When left free in the water the animals only made faint wriggling movements while sinking slowly to the bottom, but active swimming never occurred. I am therefore inclined to doubt Berg's statement. Schuster (1915) states *Ophidonais serpentina* to swim "mittels schlängelnder

Bewegung". PIGUET, however, never saw it swim, and neither have I (though I had not so many occasions on which to observe it) nor does anybody else mention anything about swimming.

There are, however, some exceptions which oppose the hypothesis. Thus, *Dero perrieri* (= *D. obtusa*) was stated by PIGUET to swim with transverse horizontal movements, (though my *D. obtusa* did not), and MARCUS (1943) states the same for *Aulophorus carteri* and *A. furcatus*, though these species have a displaced dorsal vessel. *Pristina americana* has a displaced vessel, in contrast to the other *Pristina* (about *Pr. menoni* see p. 215).

As VEJDOVSKY (1884) stated, the dorsal and ventral vessels in the pharyngeal region of *Chaetogaster cristallinus* are atrophied (see also PIGUET, 1906, STOLTE, 1933—40, and others). As reported in the systematical section (p. 69) some specimens show the common *Chaetogaster* condition. — In *Ch. krasnopolskiae* Lastočkin, the dorsal and ventral vessels are absent in front of the transverse vessel.

The commissural vessels. In most Naids there are commissural vessels, uniting the longitudinal vessels, in a number of anterior segments only, often only those formed in a budding-zone, i. e. 5 or 7 (*Pristina*). Often the loop belonging to segment I is reduced. The loops may show all degrees of complexity, from the simplest stage, with all loops simple and free, or with only occasional branchings or anastomoses, to a complicated network, where it is impossible to discern any main vessels. The former condition is found in *Stylaria*, *Arcteonais* (WOLF, 1928), *Ripistes*, *Piguetiella* (cf. also PIGUET, 1906), *Allonais pectinata* (AIYER, 1930), many species of *Pristina* (cf. the systematical section), some *Nais* (cf. PIGUET, 1906, and the systematical section), and *Homochaeta lactea* (ČERNOSVITOV, 1937 b).

VEJDOVSKY (1884, p. 113) had a very peculiar conception of the transverse loops in *Pristina* and "*Naidium*". He writes: "Auch *Naidium* hat nicht verästelte Anastomosen im 3., 4. und 5. borstentragenden Segmente; während aber dieselben bei *Pristina* dicht *hinter* den Dissepimenten aus dem Rückengefässe hervorgehen und sicht direkt zur Bauchseite begeben (Taf. II. Fig. 13, *5*, *6*, *7*), entspringen die Seitenschlingen von *Naidium* dicht *vor* den Dissepimenten der betreffenden Segmente, begeben sich links und rechts der Leibeswandung entlang um in dem Vordertheile der Segmente sich mit dem Bauchgefässe zu vereinigen (Taf. III. Fig. 7. *vs*)." The observation about *Pristina* (*longiseta*) is erroneous; the remarkable statement about the condition in "*Naidium*" (*luteum*) is no doubt due to his having had a Tubificid before him, not a Naid (cf. p. 212). FUCHS (1907, p. 453) advances VEJDOVSKY's statements (as usual without mentioning the source).

Slightly more frequent anastomoses are found in most species of *Nais*, esp. *N. communis* (cf. Piguet, 1906, and the systematical section), *Vejdovskyella comata* (cf. also Vejdovsky, 1884, and Schuster, 1915), and *Ophidonais serpentina* (p. 101, and Vejdovsky; Schuster; Piguet, 1906). When a real net-work of capillaries is formed, it may show various conditions. Thus, in *Pristina rosea* the transverse loops in I—III form a plexus, while those of IV—VII are free and simple (see p. 210), and in *P. americana* there is a plexus in II—V, with free loops in VI—VII (Černosvitov, 1937 b). In *Uncinais uncinata* (cf. also Bretscher, 1899), *Homochaeta naidina* (Bretscher, 1896), *Slavina appendiculata* (p. 135), *Allonais paraguayensis* (Marcus, 1943), and *Pristina amphibiotica* (Lastočkin, 1927; cf. p. 218) all the loops are dissolved into the plexus. This is also the case with the anterior loops in *Dero*, *Aulophorus*, *Allonais inaequalis* (Mehra, 1920), *Allonais chelata* (Marcus, 1944), *Specaria josinae* (Stolte, 1933—40, p. 407, erroneously states that Vejdovsky found 5 free loops here), and *Paranais* (I—IV), but here an additional free loop is found in some of the next-following segments: 1 loop in *Specaria* (branching once), 2—3 in *Paranais*, and from 3 to about 10 in the rest, except *Allonais chelata*, where they are stated by Marcus to be present in most segments at the niveau of the setal bundles. In *Allonais inaequalis*, *Dero*, and *Aulophorus* these free loops are attached to the anterior face of the septa. In *Uncinais* the capillaries are concentrated on the inner surface of the body wall (cf. Bretscher, 1899); in *Specaria* they are found on the wall as well as in the whole space between the wall and the alimentary canal (cf. p. 96), and in *Paranais*, *Dero*, and *Aulophorus* they are concentrated around the latter, and even interwoven with the septal glands (see pp. 19, 85, 88).

In *Haemonais* and *Branchiodrilus* the conditions are extremely complicated. Here, there is a plexus in the anterior end, and a pair of transverse vessels in each segment in the whole body, branching to the body-wall, and, in *Branchiodrilus*, giving off branches into the gills (Bretscher, 1900; Bourne, 1890; Stephenson, 1912, 1915 a; Yamaguchi, 1938, and others; cf. also the systematical section). These two genera, together with *Aulophorus superterrenus*, according to Marcus (1943), are the only ones so far known with certainty to have commissural vessels in all segments (Vejdovsky, 1884, p. 114 reports fine branches to the body-wall in all segments in *Stylaria*, but nobody else mentions them, nor have I found any, so he has probably been mistaken). In *Specaria* there are none behind VI (see pp. 96—97).

In *Paranais litoralis*, Bourne (1890) found a loop in each budding segment at the posterior end. I found the same condition in *P. botniensis*. The loops are fairly close to the alimentary wall, but quite free. In Bourne's Pl. XXVI, fig. 2 the loops in segments XVIII—XXI are apparently those of V—VII in the full-grown second zooid, though he has pictured one too many. There are no loops persisting in the middle of the adult body, as Stephenson (1913 b) supposed.

In *Dero digitata* I found, in the newly-formed segments at the posterior end, a pair of transverse vessels in each segment adhering to the anterior side of the septa, as in a number of the segments behind V (p. 177).

In *Pristina synclites*, Stephenson (1925 c) found loops to the body wall in the hinder segments of the posterior zooid.

In *Chaetogaster* and *Amphichaeta* the number of transverse vessels is greatly reduced, being one pair in IV, in *Chaetogaster* (not 2 pairs, as Stolte, 1933—40, p. 406, erroneously cites after Gruithuisen), or, in *Ch. krasnopolskiae*, only one unpaired vessel, and none in *Amphichaeta*.

The transverse vessels in the anterior segments are always more or less contractile, though the contractility is hardly perceptible, when they form a plexus. In some forms some vessels are especially contractile, and wider than the rest, and are then often called hearts (*Dero*, *Aulophorus*, *Pristina*).

In mature animals, loops are formed in the genital segments, following the inner side of the egg-sac and sperm-sac (cf. also Vejdovsky, 1884). In *Paranais botniensis* this new-formation of vessels is rather excessive (see p. 89).

The reproductive organs.

The gonads. The testes and ovaries of *Stylaria lacustris* were described and figured by Vejdovsky (1884, pp. 133, 135, Pl. IV, figs. 1, 2) as pear-shaped masses attached to the sides of the ventral nerve-cord behind the septa in V and VI, the testes being considerably larger than the ovaries. Later Mehra (1924) and Stolte (1933) studied them in greater detail. Mehra describes the testes as large masses of nuclei in a sparse syncytial cytoplasm. They are attached to the posterior face of septum 4/5 on each side of the ventral nerve-cord, and stretch back through the whole segment. The posterior part is divided into three lobes, which at a slightly more advanced stage break up into sperm morulae. At an early stage in the sexual development the testes lose their connection with the septum and disappear, giving rise to spermiocytes which assemble in the sperm-sac. Stolte (1933) describes the testes as masses of blastocytes with large nucleoli, attached to the posterior face of septum 4/5.

I found the testes in *Stylaria* attached to septum 4/5 as well as to the sides of the ventral nerve-cord (Pl. XI, fig. 2). An early stage showed immediately behind the septum some very large cells, 15—30 μ long, with nuclei 10—15 μ, nucleoli about 3 μ, and scanty chromatin, obviously the

"Urkeimzellen" of Stolte (Pl. XI, fig. 2 *u*). Then come spermiogonia, 10—15 μ long with nuclei 8—10 μ and nucleoli 2.5 μ, with a considerably more dense chromatin (Pl. XI, fig. 2 *spg*), and outwards of and above these are smaller spermiogonia, 6.5—8 μ long with nuclei 5—6 μ, nucleolus 1.5 μ and very dense chromatin. Farthest back there are mitotic stages, and spermiocytes, 4—5 μ in diameter with nuclei 3—4 μ and very small nucleoli, about 0.5 μ. Cell boundaries are visible — it is no syncytium.

In *Piguetiella*, the testes showed themselves to be composed of three stages of sperm cells: in the foremost part large spermiogonia, containing a very large nucleus with sparse chromatin and a clear space round the nucleolus, and with very little cytoplasm (Pl. XII, fig. 3 *spg*). Behind and outwards of these are smaller cells of the same appearance which have a more dense chromatin further back. In the posterior parts there are many mitoses, marking the formation of spermiocytes (Pl. XII, fig. 3 *spc*).

In most species the testes seem to break up and disappear entirely at a very early stage (this is the case in e. g. *Piguetiella*) but I found them to persist for a very long time in *Stylaria*; for instance, they are still discernible in a specimen which has already copulated, though no large spermiogonia seem to be left. In *Uncinais*, too, they persist for a long time.

There are various opinions as to the testes of *Chaetogaster*. Lankester (1869 b) described the testes of *Ch. limnaei* as two pyriform masses between the second and third septa (in V), each apparently fixed to a stalk (op. cit., Pl. XIV, fig. 5). It seems that these are in fact the spermathecae, as he found no such organs, and he identifies them with the "réceptacles séminaux" figured by d'Udekem (1861, fig. 2) in *Ch. diaphanus*, which are undoubtedly spermathecae. Vejdovsky (1884, Pl. V, fig. 4) found the testes in *Ch. diaphanus* to be rather loose masses of spermiogonia lying on the first pair of nerves of V, behind septum 4/5. According to him the different spermiogonia break loose from the testes and become fixed to various organs, such as the ventral nerve-cord, the alimentary wall etc., where they divide. The spermiocyte-morulae, in their turn, float loose in the body cavity. L. Dehorne (1916) confirms Vejdovsky's description. Stephenson (1922 c) in *Chaetogaster orientalis* (= *Ch. diaphanus*) found no traces of testes; he only saw sexual cells attached to strands of connective tissue in the body-cavity, or to the body wall, and considers them to have originated there, the morulae later becoming free in the body cavity. He supposes the testes found by Vejdovsky to be only groups of spermiogonia, occasionally developing at this place. This diffuse sperm-formation was also found by A. Dehorne (1923) who saw sperms formed in all segments behind VI.

I found unmistakable testes both in *Ch. diaphanus* and *Ch. cristallinus* (cf. p. 70). They are attached to septum 4/5 and to the ventral nerve-cord

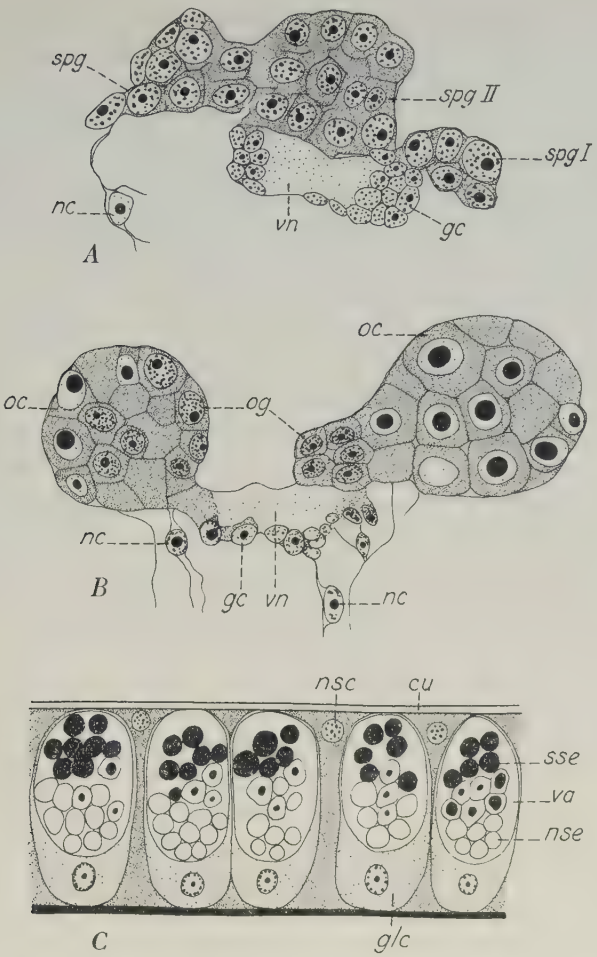

Fig. 5. *A-B Chaetogaster diaphanus.* *A* testes, *B* ovaries, transverse sections, *C Piguetiella blanci.* Clitellum, late stage of formation. *cu* cuticle, *gc* nucleus of ganglionic cell, *glc* gland cell, *nc* nucleus of connective tissue cell, *nsc* nucleus of supporting cell, *nse* non-stained secretion, *oc* oocyte, *og* oogonium, *spg* spermiogonium, *sse* stained secretion, *vn* ventral nerve-cord. *A*, *B* 800 ×.

(Fig. 5 *A*), just as in other Naids, and are surrounded by connective tissue. In *Ch. diaphanus* the anterior parts contain spermiogonia I (Fig. 5 *A spg I*) with a diameter of about 8 μ, the nuclei of which have a dense chromatin (contrary to the conditions in *Stylaria* and *Piguetiella*), a diameter of 5—6 μ, and a large nucleolus (about 2 μ). Further back the spermiogonia form groups, and in some of the groups the cells are considerably smaller than the anterior ones, about 5 μ in diameter with nuclei about 3 μ, apparently the spermiogonia II. Thus, the testes are fairly irregular in shape, as usual, the length of the whole aggregate being 50—60 μ. Immediately behind and above these are groups of spermiocytes round their cytophores, later lying loose in the coelom (cf. Pl. I, fig. 5 *spc*). Thus, all stages are represented here, and there is no need to assume any development in the connective tissue. There are, in fact, nuclei fairly much resembling the nuclei of the spermiogonia to be found in the strands of connective tissue, but they have hardly any cytoplasm at all, are very light with a scanty chromatin, contrary to the nuclei of the spermiogonia, and are also smaller than these, about 5 μ, but occasionally up to 6.5 μ (Fig. 5 *A*, *nc*). In fact, I can find no reason to believe that they are anything but the nuclei of the connective tissue cells themselves, as they are found everywhere in it. STEPHENSON distinguished the male cells from the ordinary connective tissue cells by their larger nuclei (7 μ or less against 4.3—5 μ) and the arrangement of the chromatin which is stated to form a ring in the centre of the nucleus in the former but show no special arrangement in the latter. It seems to me that this ring is simply the edge of the nucleolus, which can certainly be found in the ordinary cells, too (cf. op. cit., Figs. 2—5).

The testes disappear very early, before any of the other reproductive organs save the ovaries and the first rudiments of the spermathecae have developed. In *Amphichaeta* there are also definite testes (p. 78; Pl. II, fig. 4 *t*).

The ovaries in the *Naididae* have been found by various authors, being easier to find than the testes, as they develop more slowly and persist considerably longer. In *Stylaria* they have been mainly described by VEJDOVSKY (1884), MEHRA (1924), and STOLTE (1934). According to STOLTE they contain a very large "Ureizelle" or oogonium I, nearest to the point of fixation, and behind and above this, smaller oogonia II, containing large nuclei with scanty chromatin, but with smaller nuclei than the spermiogonia. At the periphery there are "rosettenförmige" groups of considerably larger oocytes with more cytoplasm and darker, net-like chromatin. These groups lose their connection with the ovary and are found as "Teilovarien" in the ovisac. I can confirm these statements for *Stylaria*, *Piguetiella* (Pl. XII, fig. 4), and *Uncinais*. In *Stylaria* there was one "Urkeimzelle", oogonium I, 18 μ long with nucleus 11 μ, nucleolus 2.5 μ, and scanty chromatin; then oogonia II, 11 μ long with nuclei 8 μ, nucleoli 2 μ, and denser chromatin, and smaller ones 6—8 μ, with nuclei 5—5.5 μ, and nucleoli 1.2 μ. I found nothing like the large neoblasts STOLTE found in the vicinity of the gonads (op. cit., Fig. 3 c), only the nuclei of the peritoneum, especially of the septa, which are much smaller. In *Piguetiella* there was also a large oogonium nearest to the point of fixation at the nerve-cord (Pl. XII, fig. 4 *og*), then cells with mitosis, and, at the periphery, oogonia II.

STOLTE does not mention or figure any connection with the ventral nerve-cord, but I usually found the ovaries, as well as the testes, attached to the sides of it, and to the septum in front. The ovaries always persist much longer than the testes and they are often found in fully mature specimens, which have already copulated. STOLTE also describes the further development of the oocytes.

In *Chaetogaster diaphanus* VEJDOVSKY (1884) and L. DEHORNE (1916) found ovaries in VI, attached to the sides of the ventral nerve cord behind septum 5/6 (VEJDOVSKY, 1884, Pl. V, fig. 4). LANKESTER (1869 b, Pl. XIV, fig. 4) and VEJDOVSKY (1884, p. 145) found them in the same place in *Ch. limnaei* (LANKESTER occasionally found an additional pair in VII). STEPHENSON (1922 c) is not sure whether definite ovaries are formed, or whether the oogonia are formed in the same way as he proposed for the spermiogonia. A. DEHORNE (1923) found no ovaries; the oogonia are stated to be diffusely formed by the connective tissue everywhere in VI, in analogy with the spermiogonia.

I found quite definite ovaries in both *Ch. diaphanus* and *Ch. cristallinus* (Pl. II, fig. 1 and Fig. 5 *B*, p. 43). They are pear-shaped, definite in outline, and attached to the sides of the nerve cord and to the vestiges of septum 5/6. The chromatin of the oogonia is denser than in the oogonia of the common Naids (cf. above on the testes), otherwise they resemble these. In *Ch. diaphanus* the ovaries are about 60 μ long and 30—50 μ in other dimensions. The oogonia are slightly smaller than the spermiogonia, about 5—6 μ in diameter, with nuclei 4 μ and nucleoli 1—1.5 μ. The oocytes have a very scanty chromatin and an immense nucleolus. As usual they form "Teilovarien" after separating from the ovary.

As pointed out by STEPHENSON and others, *Chaetogaster* forms sexual organs while fission is still going on, and sperms and ova are found in the posterior zooids, too. I could not with certainty find any definite gonads here, owing to the difficulties of identifying things in the budding-zones, but I think that it is most probable that they exist here, too.

The clitellum. In earthworms (see e. g. STOLTE, 1933—40) the clitellum contains three sorts of gland-cells besides the common epithelial "supporting cells": mucous cells, corresponding to those of the ordinary epidermis, and giving rise to the mucous tube connecting the worms during copulation, finely granular cells, secreting the albuminous fluid of the cocoons, and cells with large granules, which form the cocoon itself. The origin of these two latter sorts is not known with certainty.

In *Tubifex*, DIXON (1915) found narrow supporting cells, with nuclei at varying levels, and one type of gland cells with basal nuclei and granular contents, which, at the full development of the clitellum were more or less filled with globules of a secretion, forming the cocoon (op. cit., Pl. III, fig. 12). These obviously correspond to the cells with large granules in the

Lumbricidae. DIXON states that they are the ordinary gland cells of the epidermis, which are numerous and have granular contents. She does not report any mucous cells, which is not surprising, as no mucous tube is secreted during copulation in the *Tubificidae.* Where the albumen in the cocoon comes from, however, does not seem clear. VEJDOVSKY (1884) had already seen something similar in Enchytraeids. He states that the gland cells developed from ordinary "hypodermical" cells.

Very little has been written about the clitellum in the *Naididae.* VEJDOVSKY (1884) reports it to consist, like that of the *Enchytraeidae, Tubificidae, Discodrilidae,* and *Lumbriculidae,* of one layer of large gland cells with basal nuclei, and in the Naids the secretion is present "in grösseren, glänzenden Tropfen meist in zierlicher Anordnung in dem Innenraume jeder Drüse". MEHRA (1924) writes only: "The cells usually contain one large vacuole and a few small ones; the walls are lost and the nuclei lie near the margins." He also states that the clitellum is four times as thick as the ordinary epidermis.

I have investigated the clitellum more closely in *Stylaria* and *Piguetiella.* As in *Tubifex* it consists of glandular cells and "supporting" cells. During the development of the clitellum the large secretory globules appear in the cytoplasm of the former, and grow more and more numerous, while the cells grow higher and higher, and the cytoplasm is limited to the walls and the bottom. The nucleus is basal. At its fullest development the clitellum in *Stylaria* becomes as much as 50 μ thick on the dorsal side—about 10 times as thick as the ordinary epidermis in this region. Then, almost the whole of the cell is taken up by a vacuole crammed with secretion, while the nucleus is pressed to the bottom of the cell and may even be hardly conspicuous, especially in *Piguetiella* (Pl. XIII, fig. 5), where the gland cells are not so high and narrow as in *Stylaria* (Pl. XI, fig. 1). The cell borders are not lost, as reported by MEHRA. The secretory globules vary very much in size. In *Stylaria* they attain about 5 μ in diameter, being irregularly roundish, and flattened against each other. With eosin they stain pink or reddish brown; with iron haematoxylin from faintly yellow to black. Usually not all the globules stain alike. In any cell the innermost globules may stain very faintly, those a little further outwards black only in the centre, and the outermost ones wholly black (Fig. 5 *C*, p. 43). This phenomenon apparently depends on the age of the secretion, the newly-formed staining more faintly than the ripe. The cocoon-wall stains quite the same, pink in Ehrlich's haematoxylin and eosin, and blackish blue in iron haematoxylin.

Between the gland cells are ordinary epidermal cells, which become closely pressed together, when the gland cells grow. They constitute the "supporting cells". At last there is nothing to be seen of them except the outermost part, below the cuticle, where a little cytoplasm with the nucleus is left (Pl. XI, fig. 1 *nsc*).

I found no mucous cells — no mucous tube is formed here on copulation (Ditlevsen, 1904, p. 460). Ditlevsen reports a mucous sheath round the cocoon (op. cit., p. 470), but I could not find one. The whole wall, and the flat, irregular sheath fixing the cocoon to the substratum, stain exactly the same as described above, no traces of mucus being found. Apparently the cocoon wall itself is sticky when newly secreted.

As to the origin of the gland cells, they seem to be formed from ordinary epidermal cells. In the epidermis of the non-sexual individuals, mucous cells are found on the prostomium (cf. also Dehorne, 1916), but on the rest of the body they are fairly scanty, and could not give rise to the numerous clitellar gland cells, even if such a transformation were in itself possible. No other gland cells were found in the ordinary epidermis; that of the region of the future clitellum being only higher than that of the following parts of the body. In some preparations part of the cells had more basal nuclei than the rest, and these may perhaps later become gland cells.

The clitellum is usually thicker dorsally. Ventrally, it is most often absent round and between the male pores. This is the case in e. g. *Stylaria* and *Nais*. Here the gland cells of the clitellum nearest to the male pores, have each one vacuole with quite clear, non-staining, but refractive contents (Pl. VIII, fig. 1, Pl. XI, fig. 3). This secretion may have some function during copulation.

In *Piguetiella* the clitellum is present on the whole ventral side posterior to the spermathecal pores, but in the part anterior to, and round the male pores, it has not the same appearance as usual. The cells each contain one large vacuole, the contents of which are granular, though much finer than that of the common clitellar cells (Pl. XII, fig. 5 *cl*). I cannot comment on the significance of this difference as I do not know whether the cocoons in this species are somehow different from the common type.

In *Paranais botniensis* the clitellum has the same appearance between the male pores as elsewhere (Pl. III, fig. 7); it is apparently also present between the male pores in *Branchiodrilus*, *Stephensoniana*, and some *Allonais*. In *Pristina* the conditions vary.

The male efferent apparatus. The funnels are usually cup-shaped, though often more or less deformed by pressure in the sperm-sac. In *Stylaria*, and especially in *Slavina evelinae* (Marcus, 1944), they are strongly enlarged, the outer and lower (originally dorsal) wall extending very far along the wall of the sperm-sac. In *Dero digitata* the anterior (originally ventral) wall is considerably lengthened, the dorsal short (Pl. XVII, fig. 3).

The funnels consist of cubical or columnar, ciliated cells, usually higher at the base of the funnels.

The vasa deferentia, straight or coiled tubes of very varying length, usually have a more or less cubical, ciliated epithelium with well-defined cell-partitions. (MEHRA, 1924, and YOSHIZAWA, 1928, found it to be non-ciliated in *Stylaria lacustris* and *S. fossularis*, respectively; I saw ciliation in the former, but it is often difficult to see). The epithelium sometimes is very low, as in some *Nais*, *Dero*, and *Uncinais uncinata*. In *Paranais* it is extremely low, and the lumen very narrow, which makes the sperm-ducts here extremely thin (Pl. III, fig. 4 *vd*). In some cases the epithelium is slightly glandular, in a few cases even strongly: in *Nais elinguis* (Pl. IX, fig. 1; cf. MEHRA, 1924), *Stylaria lacustris* (only the hind part, Pl. XI, fig. 3; cf. MEHRA, 1924), *Specaria* (Pl. IV, fig. 3), *Pristina longiseta* (PIGUET, 1906; MARCUS, 1943) and *evelinae* (MARCUS, 1943), and obviously in *Pr. biserrata* (CHEN, 1940, Fig. 14 *B*). In *Stylaria* the cytoplasm is granular and eosinophil, in *Specaria* vacuolated and almost non-staining. — Often it is very difficult to judge whether the epithelium is slightly glandular or not.

In a number of cases the sperm-duct is surrounded for a longer or shorter part of its course by the so-called prostate gland cells which may be scattered, to very dense. These are pear-shaped or roundish, basophil cells, with a vacuolated or sometimes granular cytoplasm (see below). They occur in *Nais*, *Ophidonais* (MICHAELSEN, 1903 b; PIGUET, 1906), *Uncinais* (cf. PIGUET, 1906, 1909), *Specaria*, *Pristina biserrata*, *plumaseta* (TURNER, 1935), *breviseta* (STEPHENSON, 1926 a), *americana* (ČERNOSVITOV, 1937 b), and in *Stylaria lacustris* (but not *fossularis*). Thus, prostate cells are combined with a not (or only faintly) glandular sperm-duct wall in most species of the first three genera and most *Pristina*, and with a strongly glandular wall in *Nais elinguis*, *Specaria*, *Stylaria lacustris*, and probably *Pristina biserrata*, while the wall is glandular without prostate in *Pristina longiseta* and *evelinae*, and not or only slightly glandular without prostate in the rest, as far as can be deduced from the literature and my own investigations.

The vasa deferentia join the atria at the top in *Pristina*, *Piguetiella*, *Homochaeta*, *Chaetogaster*, and possibly *Stephensoniana* (AIYER, 1930), and at various heights in the anterior wall, generally to the outer side, often immediately above the ejaculatory duct, in the rest (see the various species in the systematical section).

The atrial epithelium has been shown by MEHRA (1924) to be ectodermal in origin, contrary to the sperm-duct which is mesodermal. There is always a more or less strong muscular layer outside the epithelium (formed by the muscular layers of the body-wall, according to M.), especially strong in

Paranais litoralis and *Nais elinguis*, and usually, at least, a peritoneal covering. The atria may be weakly developed (e. g. most *Pristina*), but also so large as to fill up almost the whole segment (e. g. *Piguetiella* and *Stylaria*). — The inner side of the body-wall round the opening of the atria is often covered with gland cells (cf. e. g. Pl. XII, fig. 5; also PIGUET, 1906).

The atrial epithelium is non-ciliated (occasional statements about ciliation, e. g. MARCUS, 1943, on *Dero evelinae*, seem obscure), often cubical, with homogeneous cytoplasm. In many cases it is, however, more or less high, and the cytoplasm granular or vacuolated, thus offering a glandular appearance. Often this condition is combined with the occurrence of a prostate covering of varying density and extension. The atrium and the prostate cells have been described by MEHRA (1924, 1925), especially in *Stylaria lacustris* and *Slavina punjabensis* (= *appendiculata*). The prostate cells are, according to him, formed by the peritoneum, and thus mesodermal in origin. They are stated to be conical, with the nucleus in their broader, outer end. The cytoplasm is basophil round the nucleus and at the borders, while the proximal part of the cell is filled with a secretion, taking eosin stain. This secretion is stated to flow through the epithelial cells, which would not in themselves be glandular, giving them the same appearance as the prostate cells, and finally breaking them up completely, so that they would lose their structure and their cell borders. STEPHENSON (1915 c), on the other hand, did not consider the prostate cells (in *Slavina*) to be glandular, because he considered them to be peritoneal, and because he could find no penetration of the muscular coat. He described them as having a reticulate cytoplasm, including non-staining spaces. — HRABĚ (1936 b) has shown that both the diffuse prostate in the Lumbriculid *Lamprodrilus mrázeki* and the solid prostates in several Tubificids are ectodermal (MEHRA stated them to be mesodermal in the *Tubificidae*). He concludes that probably all atrial prostates in the *Lumbriculidae*, *Tubificidae*, and *Naididae* are actually ectodermal (emanating from the atrial epithelium).

I have studied the conditions in all species where I have found sexual organs, and in greater detail in *Stylaria lacustris*. I have found the appearance of the prostate cells to vary rather much with the maturity of the specimens. Generally it agrees with STEPHENSON's description, with a reticulate, basophil cytoplasm, containing non-staining vacuoles, and similar to that of the vasa deferentia described above. At a very advanced stage a large vacuole is found outwards of the nucleus (Pl. XI, fig. 4 *va*), but only in one specimen, where oviposition had already taken place, was the secretion granular (Pl. XI, fig. 3). The epithelium of the atrium (and sperm-duct), however, contains a strongly granular and eosinophil secretion (Pl. XI, figs. 3, 4), quite resembling the secretion found in the atrial lumen. I never found the cells disintegrating and losing their borders;

they always retain their individuality, even at the most mature stages (cf. Pl. XI, figs. 3, 4). I think that MEHRA's frequent failure to find cell borders may be due to his use of Bouin's fluid as a fixative; this is often very unfavourable for tracing borders, and often gives the impression of syncytia, etc. I do not, therefore, share MEHRA's opinion on the mode of secretion, but consider the epithelial cells themselves, as well as the prostate cells, to be glandular. As to the latter I have not found any direct connection with the atrial lumen, but in places I saw their inner ends penetrate the muscular layer (Pl. XI, fig. 4 *nepr*), so presumably their secretion escapes between the epithelial cells, though it is impossible to trace, being non-staining. One fact which would seem to support MEHRA's opinion, is that in all species where the atrium has a prostate covering, its epithelium is also glandular (*Stylaria*, *Ripistes*, *Arcteonais* (?), *Slavina*, *Vejdovskyella*, *Piguetiella*, *Stephensoniana*). It is, however, obviously glandular also in the following genera without prostate: *Branchiodrilus* (CHEN, 1940: "with high but vacuolated epithelium"; MEHRA, 1925, did not consider the epithelium to be glandular in this species), *Haemonais* (STEPHENSON, 1915 a: "It is lined by a tall, non-staining epithelium, the cells showing a multitude of minute granules scattered in a clear groundwork"), most *Dero s. str.* (*D. digitata*, at least), *Aulophorus*, *Chaetogaster* and *Amphichaeta*, and probably in some *Allonais* (cf. p. 207), too, though it does not appear with certainty in the descriptions. In *Chaetogaster*, *Amphichaeta*, and *Dero* the epithelium is strongly vacuolated, though not granular (Pl. I, fig. 6, Pl. II, fig. 5, Pl. XVII, figs. 4, 5).

Thus it seems that some part of the male efferent apparatus, either the vas deferens, the prostate of this, or the atrium, with or without prostate, or a combination of several of these, is glandular in all Naids, except *Paranais*, probably some *Allonais* (cf. p. 207), and possibly *Pristina amphibiotica* and *idrensis* (which have, however, only a vestigial apparatus). The histology of the atrial wall in *Homochaeta* is not described and cannot be deduced from the figure. The secretion is considered to agglutinate the sperms, but does not seem to be absolutely necessary if the above-mentioned forms really lack it. (I am not quite sure of *Paranais botniensis*; the high cells of the epithelium at the bottom of the atrium are somewhat granular, and may be glandular, Pl. III, fig. 6.) Where the secretion is most abundant it seems that the sperms form bundles (this holds true for *Stylaria* and *Piguetiella*, at least; as to *Ophidonais*, it has at least a very thick prostate covering on the vas deferens, judging from the figures of MICHAELSEN, 1903 b, and PIGUET, 1906). "Spermatophores" are described in *Stylaria* and *Ophidonais*, and are found in *Piguetiella* too, though they do not seem to really merit this name, being merely bundles of parallel sperms, sticking together, and not in any definite formation (in *Ophidonais* they are long and coiled, see e. g. PIGUET, 1906). STOLTE, 1933—40, writes that MEHRA considers the large size of the spermathecae in the two former as being caused by the formation of spermatophores; MEHRA, however (1924) writes that "the fact whether or not the sperms are packed into spermatophores does not necessarily affect the size of the ampulla" citing PIGUET (1906, who believed the abscence of spermatophores in the *Naididae* to be responsible for their large spermathecae). From the above it appears that the prostate may be present either on the vasa deferentia or the atrium, but only in one species is it known to occur on both, namely *Stylaria lacustris* (not in *Stylaria fossularis*, judging from YOSHIZAWA, 1928). VEJDOVSKY (1884, Pl. IV, fig. 10) does not figure any prostate on the vas deferens of *S. lacustris*; it may therefore possibly be sometimes absent, though SCHUSTER (1915), MEHRA (1924), and I have always seen it. Here, the epithelium of the part of the vas deferens supplied with the glands wholly resembles that of the atrium, being high and granular. This part is also surrounded by the strong muscular layer, and it seems to belong developmentally to the atrium. From MEHRA's (1924) description and his Pl. IV, fig. 6, it can be seen that when the sperm-duct cord grows back towards the atrium, this also grows considerably forwards, getting rather narrow here. The picture contrasts strongly with that of *Nais elinguis* (op. cit., Pl. IV, fig. 11), where the atrial rudiment has a much more definite form, and the long sperm-duct cord grows backwards the whole way towards it.

The ejaculatory ducts, when such are present, are formed by a non-glandular epithelium surrounded by the muscle layer and the peritoneum. The epithelium is usually higher than that of the atria, and distinguishable from this, and also from the epithelium of the body wall, where they open. They are well developed and long especially in *Chaetogaster* and *Amphichaeta*, *Paranais*, *Dero*, some *Aulophorus*, *Branchiodrilus* (MEHRA, 1920; CHEN, 1940), and *Pristina evelinae* (MARCUS, 1943), and well-marked, though often short in *Nais*, *Uncinais*, *Ophidonais*, *Haemonais* (STEPHENSON, 1915 a), and obviously in most *Allonais* (CHEN, 1940, and others). In most *Pristina*, *Specaria*, *Vejdovskyella*, *Slavina*, and *Ripistes* they are conspicuous, but their epithelium does not differ from that of the atrium. In *Homochaeta* (MOSZYNSKI, 1933), *Piguetiella*, *Stylaria* (cf. SCHUSTER, 1915, MEHRA, 1924, YOSHIZAWA, 1928), *Arcteonais* (PIGUET, 1928), and *Stephensoniana* (AIYER, 1930) it is hardly possible to speak of an ejaculatory duct — the atrium opens directly outwards. In not wholly mature *Piguetiella* and *Stylaria*, the atrium was narrower at the bottom, suggesting a duct, and the clitellum-free part of the body-wall round the pore in *Stylaria* (as well as in other species) was slightly pushed inwards, forming a pit, often mentioned in descriptions (e. g. MEHRA), this was also the case in the specimen examined after oviposition (Pl. XI, fig. 3). In mature individuals, which have copulated, both the atrial narrowing and the pit have disappeared, and the atrium opens directly outwards at the level of the body-wall. In *Pristina idrensis* (Pl. XX, fig. 5), and *Pristina breviseta* the two ducts open together, in the latter into a groove in the body-wall (STEPHENSON, 1926 a). In *Slavina evelinae* (MARCUS, 1944), they open into a common eversible "ejaculatory chamber", and in *Specaria* (p. 98, Pl. IV, figs. 4, 5) each duct opens into an eversible pocket.

The genital setae. In all Naids, the ventral setae of the atrial segment seem to disappear during the formation of the clitellum. In most cases new setae, usually called penial setae, develop in the immediate vicinity of the atrial duct. Rarely are special setae formed in, or immediately in front of, the spermathecal segment too, or only there. In these cases the common setae of this segment fall out, too, but not otherwise. Genital setae are entirely absent in *Amphichaeta*, *Aulophorus* (as far as known), most *Dero*, *Allonais gwaliorensis*, and, as it seems, *Pristina idrensis.*

The setal sacs of the penial setae are usually situated medially from the atria, and the setae penetrate the body-wall immediately behind, or sometimes in front of, the opening of the atrial duct, in *Specaria* even in front of the pocket into which the latter opens (Pl. IV, fig. 4). The muscles of the setal sacs are very strong and numerous, as described by PIGUET, SCHUSTER, and others. The setae usually point more or less forwards, with the hook pointing upwards. SCHUSTER (1915, p. 32, on *Vejdovskyella comata*) considered it probable that they function as penes during copulation, being inserted into the opening of the spermathecal duct, so that the sperm can flow along them, and uniting the animals with their hooks. When, however, the spermathecae open laterally, as in *Specaria*, this is rendered impossible, so presumably the setae anchor in the body wall at a convenient level.

The type of the penial setae varies considerably. They wholly resemble ordinary ventral setae in *Paranais simplex* (HRABĚ, 1936), *P. friči* (HRABĚ, 1941; cf. the systematical section), and *Homochaeta setosa* (MOSZYNSKI, 1933). In these they thus apparently represent the initial stage in the transformation from ordinary setae. In *P. friči* they even seem to have retained their place in the ordinary ventral bundles (not expressly stated) in which case one can hardly speak of penial setae. Mostly, however, they are considerably larger than the ordinary setae, both longer and thicker; also straighter, often with an inconspicuous, markedly distal nodulus, and with the distal prong reduced. Transitional forms occur in *Haemonais waldvogeli* (STEPHENSON, 1915 a), and *Paranais botniensis* (p. 90, Pl. III, fig. 7), the penial setae of which are longer and straighter, but not thicker than the ordinary setae, with a conspicuous, though strongly distal nodulus, and two teeth, about equally strong. In *Dero dorsalis* (Chen, 1940, *D.* "*austrina*"), and in *Stephensoniana trivandrana* (Aiyer, 1930), the distal tooth is much reduced. In the latter both prongs are usually blunt, and in both, these setae are also thicker than the common ones, with inconspicuous noduli. The most common type, where the distal prong is wholly reduced, occurs in the following: *Chaetogaster*, *Nais* (Pl. VIII, fig. 3), *Ophidonais*, *Uncinais*, *Allonais pectinata* (Chen, 1940, "*Nais denticulata*"), *A. paraguayensis* (Chen, 1940), *Stylaria*, *Arcteonais*, *Ripistes* (Pl. IX, fig. 6), *Slavina*, *Vejdovskyella*, *Specaria*, *Branchiodrilus*, and *Paranais litoralis* (Bourne, 1891; Knöllner, 1935). However, in some *Nais*, for example, a small distal tooth may occur (cf. e. g. Piguet, 1906). It is quite obvious, that these penial setae have developed from normal ventral setae, and the occurrence in *Paranais* of a developmental series points to the possibility, that this process may have taken place more than once within the family.

Besides these more normal and widely spread types, three others occur, which are strictly exclusive. The deviating species *Dero asiatica* (Černosvitov, 1930) has penial setae which are quite straight, without a nodulus, and of the simplest possible type. The two other types are restricted to the genus *Pristina*, and are treated below.

Spermathecal setae, i. e. specially shaped setae in the neighbourhood of the spermathecal apertures, occur in the genera *Piguetiella* and *Pristina*. In the former they are straight, with the nodulus about the middle, and a broader, pointed, slightly bent distal end, where the tip represents the distal tooth, while the proximal tooth is wholly reduced or weak (Pl. XII, fig. 2). These setae are situated behind the spermathecae, projecting through the openings of a pair of pockets, surrounded by gland cells.

The rôle of the spermathecal setae will no doubt be on copulation, too, but on account of their varying situation it is still less probable than in the case of the penial setae that they should enter any opening. Possibly they keep a hold on the partner externally, and the secretion from their glands may increase the adhesion.

In *Pristina* the conditions vary extremely, as regards both the appearance, and the place of the genital setae. It is the only genus where both penial and spermathecal setae occur, even in the same species. Various forms occur. One has extremely long teeth, meeting at the ends and united by a thin webbing; the proximal end is strongly curved. The penial setae in *Pristina amphibiotica* (Pl. XIX, fig. 3) and *P. breviseta* (Stephenson, 1926 a), and the spermathecal setae in *P. longiseta longiseta* (Aiyer, 1930) and *P. breviseta* have this form. The penial setae of *P. americana* (Černosvitov, 1937 b), and the penial and spermathecal setae of *P. plumaseta* (Turner, 1935), are slightly bent, with a simple distal end and a thickening below it. The spermathecal setae of *P. longiseta leidyi* (Smith, 1896), *P. longiseta bidentata* (Marcus, 1943), *P. biserrata* (Chen, 1940), and *P. americana* (Černosvitov, 1937 b) represent modifications of the usual type. In *P. evelinae* (Marcus, 1943), the spermathecal setae (in VI, and sometimes in VII) are extremely stout, curved, with a very thick proximal prong.

As to the position of the penial setae, those of *P. americana* and *P. plumaseta* are situated in VIII, behind the atria, while the only, unpaired, seta of *P. breviseta* lies in front of the atria, either posteriorly in VII, or anteriorly in VIII, a little to the right. The exact position of the penial setae in *P. amphibiotica* has not been determined, but they lie in VIII. The spermathecal setae are usually situated in front of the spermathecae, in VI. *P. breviseta* forms an exception, the unpaired seta being situated in VII, to the left of the common spermathecal aperture, from which it projects. The posterior spermathecal setae of *P. evelinae*, too, are exceptional, being in VII, behind the spermathecae.

The genital setae in *Pristina* usually occur in connection with special glands, which either surround them, lie immediately behind them, or surrond an independent pocket, from which the setae project; mixed forms are also found. The result of this is that the setae always project more or less perpendicularly from the body-wall.

The spermathecae. The spermathecae, where the sperm from the atria is stored, are present in all Naids, except *Aulophorus tonkinensis* (Chen, 1940; cf. p. 196), *Pristina amphibiotica*, and *P. idrensis* (pp. 219, 221). The questions arising in connection with this are discussed in the special section.

The spermathecae are always simple sacs, usually with a proximal ampulla and a distal duct. There is, however, no distinct difference between the ampulla and duct in *Pristina* (except *P. americana*, Černosvitov, 1937 b), and in *Homochaeta setosa* (Moszynski, 1933) the ampulla opens directly outwards. In the rest the duct is more or less well defined, usually with a columnar epithelium. In *Nais* the shape of the duct has taxonomic significance. In *Piguetiella*, and in *Slavina* and *Vejdovskyella*, the duct is unusually long. The epithelium of the ampulla is usually flattened. In *Piguetiella* (p. 152; Pl. XIII, fig. 2) and in *Haemonais* (Fig. 27 *B*; Stephenson, 1915 a), however, it is high and irregular, with the inner end of the cells projecting into the lumen. The ampullae are very long when filled with sperm, extending back into the sperm-sac, in *Ophidonais*, *Piguetiella*, *Stylaria*, and species of *Vejdovskyella* and *Aulophorus*.

The "refractile body."

Medially, at the posterior side of the brain, in the incision between the ganglia, a small, refractive or granular formation is found in most species of *Chaetogaster*. STEPHENSON (1907 b, p. 246; 1911, p. 207) surveys the conditions described in various species. VEJDOVSKY (1884, p. 38; Pl. VI, fig. 12), who saw it in *Ch. diastrophus* as a bright, brown body, interpreted it as a chitinous plate; ANNANDALE found an "otocyst", "a relatively large transparent cyst," in the brain of *Ch. bengalensis* (1905, p. 117), and *Ch. spongillae* (= *Ch. langi*) (1906, p. 188), and "a sensory organ which is densely pigmented and probably functions as an eye" in *Ch. sp.* (= *Ch. cristallinus*?; 1906, p. 189). STEPHENSON (1907 b, p. 243, Fig. 5 A, B) describes in *Ch.* "*pellucidus*" (= *Ch. orientalis* STEPH. = *Ch. diaphanus*) "a quantity of granular, opaque matter," in an ovoid mass in the posterior part of the ganglion, extending as scattered granules along the commissures or altogether lacking. He failed to detect the "otocyst" in *Ch. spongillae* (1911, p. 207). He found "a peculiar granular and at the same time refractile body" in the brain of *Ch.* "*langi*" (= *Ch. diastrophus*), *Ch. cristallinus*, and *Ch. diaphanus* (1922 b, pp. 278—279). DEHORNE (1916, p. 67; Pl. I, fig. 8), who saw in *Ch. diaphanus* "une capsule brillante qui rapelle celle du *Chaetogaster diastrophus*", states that it consists of two enormous nuclei of ganglionic cells. She also saw, on the anterior surface of each ganglion, a "disque réfringent", consisting of "des balles de matière graisseuse."

I examined the formation in *Ch. diastrophus*. It is a roundish vesicle, about 14 μ in diameter, and half as thick as that. When the brain changes its form, as the animal is pressed under a cover-glass, the form of the vesicle also changes considerably. The contents are refractive, consisting of brownish aggregates (Fig. 6). Under harder pressure these decompose into extremely fine grains, showing Brownian movement. In sections, the vesicle appears empty, which indicates that the contents have been dissolved

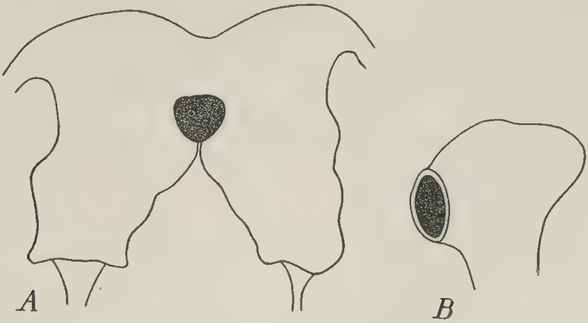

Fig. 6. *Chaetogaster diastrophus*. Brain with "refractile body", *A* from above, *B* from the right. *A* 500 ×.

during the preparatory processes. Possibly the formation functions as an organ of balance, a statocyst, as was ANNANDALE's opinion. The formations described in other species are most probably such, too, though the conditions in the specimens of *Ch.* "*orientalis*", described by STEPHENSON, and those in *Ch. sp.* Annandale seem obscure. In *Chaetogaster limnaei limnaei* no statocyst is present. This is not surprising, as these animals are dependent on the topography and the movements of their host, and not on their own position relative to the horizontal plane.

III. Systematical Section

In the lists of synonyms reference as a rule has been made only to papers containing statements of taxonomical interest. Text-books have, as a rule, not been referred to.

The generic, subgeneric, and specific descriptions have been arranged as follows — firstly the external characters, such as eyes, a proboscis, gills, etc., if such are present, and setal characters, then the presence or absence of septal glands (if nothing is mentioned, pharyngeal and oesophageal glands are present), the form of the stomachal dilatation, the number and mode of branching of the transverse commissural vessels, the position of the dorsal vessel, presence or absence of coelomocytes, and the position and shape of the genital organs. The features of the latter which have generally been used as generic characters are the presence or absence of prostate gland cells on the vasa deferentia or atria, the position of the opening-point of the former into the latter, the occurrence of genital setae, and the presence or absence of the clitellum between the male pores. These characters are usually constant for all species of a genus. Characters of specific value have generally been the shape of the spermathecae and atria, and the details of the distribution of the prostate cells. (For the subfamily *Chaetogastrinae* other characters are to some extent suitable.) — No character has been treated as exclusively and intrinsically generic or specific or of no value at all; the significance of many characters varies greatly within the family, and the value that may be attached to them must be judged from case to case.

As a rule nothing is mentioned about the situation of the foremost nephridia, though this is frequently done in the literature. The normal position of the first nephridial funnel is in the ovarial segment, and though one or both nephridia are often missing in one or two of the foremost segments, this does not usually seem to have any taxonomical significance.

The same applies to the beginning of the chloragogen; exceptions existing have been mentioned.

In the tables v. s. = ventral setae, n. s. = needle setae, h. s. = hair setae, post. = a segment in the posterior part of the body (of the first zooid).

Family *Naididae.*

Type genus: *Nais* Müller.

Prostomium usually well developed, sometimes forming a proboscis. Eyes often present. Ventral setae in an indefinite number per bundle, beginning in II; double-pointed, or seldom simple-pointed crotchets. Dorsal setae usually present, beginning in II, III, IV, V, or VI, or seldom, in full-grown individuals, farther back; consisting of an indefinite number of hair setae, accompanied by needle setae of various shapes, or of needle setae only. Alimentary canal with pharynx, oesophagus, stomach, and intestine; pharyngeal, and oesophageal or septal glands usually present; pharynx generally with a dorsal diverticulum of ciliated cells. Vascular system consisting of alimentary plexus, dorsal and ventral vessel, and a varying number of commissural vessels, from none to one or two pairs per segment, often forming a plexus in the anterior end, seldom a plexus in the body-wall; additional loops formed during maturity in sperm-sac and ovisac. Nephridia usually open, with a glandular part behind the septum; the tubule coiling, sometimes packed against the ventral vessel, sometimes invested with bladder-like peritoneal cells; beginning in the segment behind the ovarial; seldom wholly absent. Nervous system not connected with the epidermis; connectives of the nerve-cord usually fused. Clitellum in a few segments in the region of the gonads; testes and ovaries, one pair each, in IV—V, V—VI, or VII—VIII; male efferent apparatus paired; funnels in testis segment, atria in ovarial segment, usually opening apart; no penis, penial setae often present; often diffuse prostate gland cells on vasa deferentia or atria; spermathecae in testis segment, usually opening apart, sometimes accompanied by special setae; usually an un-paired sperm-sac and ovisac formed. Asexual reproduction by budding or fragmentation. Ontogeny deviating, with a periblast forming round the embryo.

Subfamily *Chaetogastrinae* subfam. nov.

Type genus: *Chaetogaster* von Baer.

Prostomium often reduced. Segment III elongated. No eyes. Dorsal setae double-pronged crotchets, or absent. Pharynx in I—III, attached to the body-wall by numerous radial muscular strands; no dorsal diverticulum; no pharyngeal, oesophageal or septal glands; stomach of special structure. Chloragogen beginning in V. Commissural vessels none to one pair. Nephridia closed. No coelomocytes. Connectives of ventral nerve-cord sometimes not fused anteriorly; cerebral ganglia often weak; conspicuous pharyngeal ganglia present. Clitellum absent between male pores; testes and spermathecae in V, ovaries and atria in VI; spermathecal and atrial ducts well-defined; no prostate; 5 segments formed at anterior end, by budding. No swimming.

Genus **Chaetogaster** von Baer, 1827.

Generic type: *Chaetogaster limnaei* von Baer.

Prostomium more or less reduced. No dorsal setae; ventral setae double-pronged or simple crotchets, absent in III—V. Septa incomplete. Oesophagus in IV; stomach well-defined. Intestinal plexus on the stomach conspicuous, with a ventral trunk; usually one pair of commissural vessels, in IV; in some cases vascular system in the pharynx region atrophied. Connectives of the ventral nerve-cord not fused in the anterior segments; cerebral ganglia usually weak, without posterior lobes; most often a statocyst present in the brain. Clitellum in 1/2 V—VI; vasa deferentia joining atria at the proximal end; penial setae present; as a rule no sperm-sac and ovisac formed. Budding and fission continuing during earlier stages of maturity. Some species predatory.

The *Chaetogaster* crotchets are characteristic, straight, with an often angular, proximal curve. The breadth increases abruptly at the nodulus, then, as a rule, decreases continually towards the proximal end (Fig. 7 *A*—*F*). The distal tooth is longer than the proximal, the difference being less pronounced in II, where the setae are longer and thicker. (The setae of *Ch. limnaei* present special features; see p. 75.) The innermost setae of a bundle are much shorter than the rest, and the large species have an unusually great number of setae per bundle.

On the body-wall in most segments, and especially on the prostomium, are found numerous sensory hairs, which are extremely long in *Ch. palustris* (p. 63).

The pharynx acts like a sucker, and the oesophagus is narrow. Its length amounts to 1/4—1/1 of that of the pharynx, but it varies within the species (cf. also Pointner, 1914 b, p. 95) and cannot as a rule be used as a character for identifying the species, as was done by e. g. Ude (1929). *Ch. limnaei* (*s. lat.*; cf. p. 72) alone has an almost inconspicuous oesophagus. For the anatomy and physiology of the rest of the alimentary canal and for the circulatory system see the anatomical section.

The nephridia are closed, without any nephrostome — thus they have no connection with the previous segment — and without any glandular part. No part of them takes colour on intra-vital staining. They have been described by L. Dehorne (1916), Boveri-Boner (1920), and recently, more thoroughly by Meewis (1938).

The nervous system was described by Vejdovsky (1884) and Dehorne (1916). The cerebral ganglia are usually weak, but in *Ch. diastrophus* and *Ch. palustris* they are built out posteriorly, each with one mass of ganglionic cells. (Fig. 6 *A*; cf. Vejdovsky, 1884, Pl. VI, fig. 12.) In the incision between the lobes at the posterior side of the brain a small, light-breaking body, possibly a statocyst, is found in most species (cf. p. 55, Fig. 6).

The male funnels are of a very regular cup-shape, and as a result of the weak development of septum 5/6 they lie practically free in the coelom. As a result of the extensive perforation of the septa (cf. Stephenson, 1922 c) — except septum 3/4, which is strong — the sexual products slip through the holes and float freely about in the body-cavity. Thus, no sperm-sac, and usually no ovisac (cf. p. 71) is formed.

The larger-sized species of *Chaetogaster* are distinguished by their extraordinary transparency, which is connected with the thinness of the body-wall, especially the muscle-layers. The transparency decreases with decreasing body-size. This is explained by the fact that the internal organs require relatively much more space in the smaller forms, so that no large vacant spaces are left between them. This, in turn, depends on the fact that the size of the cells does not decrease in the same proportion as the body-size (cf. the gigantic intestinal cells in *Ch. diastrophus*, Fig. 3 *C*).

The genus is cosmopolitan.

Chaetogaster diastrophus (Gruithuisen, 1828).

Figs. 3 *C*, 6, 7 *A*, *B*, *G*; Pl. I, fig. 1.

[?] *Nais vermicularis* Müller, 1773, p. 20 [*? partim*].
[?] *Nais vermicularis* Müller. Gmelin, 1788—1793, p. 3120 [*? partim*]. Modeer, 1798, pp. 118—120 [*? partim*]. Oken, 1815, p. 364 [*? partim*]. Lamarck, 1816, p. 223 [*? partim*]. Blainville, 1825, p. 223 [*? partim*]; 1828, p. 497 [*? partim*].
Nais diastropha Gruithuisen, 1828, pp. 416—420, Pl. XXV, figs. 7—9.
Copopteroma nais Corda, 1837, p. 390 [*fide* Michaelsen, 1900, p. 21].
[?] *Chaetogaster vermicularis* (Müller) [*partim*]. Grube, 1851, p. 105.
[?] *Choetogaster Mülleri* d'Udekem, 1855, p. 554.
Chaetogaster. Leydig, 1857, pp. 344—345, Fig. 184.
[?] *Choetogaster Mülleri* d'Udekem. d'Udekem, 1859, p. 24.
[?] *Choetogaster Mulleri* d'Udekem. d'Udekem, 1861, pp. 248—249, Pl., figs. 2—3.
[?] *Chaetogaster gulosus* Leidy, 1852 a, pp. 124—125.
Chaetogaster diastrophus (Gruithuisen). Vejdovsky, 1883, p. 221; 1884, p. 38, Pl. VI, figs. 11—15. Beddard, 1895, pp. 307—308. Bretscher, 1896, p. 511. Michaelsen, 1900, p. 21; 1909 a, p. 10. Smith, 1900, p. 443; 1918, p. 638. Piguet, 1906, pp. 200—202. Southern, 1909, p. 131. Galloway, 1911, p. 306. Piguet & Bretscher, 1913, pp. 18—19. Pointner, 1914 b, pp. 93—97. Schuster, 1915, pp. 8, 62. Svetlov, 1924, p. 189. Malevich, 1927, pp. 4—5. Ude, 1929, p. 22. Knöllner, 1935, pp. 427—428, 502, 506, 508—509. Szarski, 1936 a, pp. 103—112, Pl. IV, figs. 1—3; 1936 b, pp. 393—398. Chen, 1940, pp. 31—32. Marcus, 1943, pp. 11—13, Pl. I, fig. 1.
Chaetogaster Mülleri d'Udekem. Timm, 1883, p. 154.
Chaetogaster vermicularis (Müller). Vaillant, 1890, pp. 446—447.
[?] *Chaetogaster gulosus* Leidy. Vaillant, 1890, p. 451.
Chaetogaster punjabensis Stephenson, 1907 a, pp. 133—138, Pl. V, figs. 1—11.
Chaetogaster punjabensis Stephenson. Stephenson, 1907 b, pp. 246—251; 1920, p. 196.
Chaetogaster annandalei Stephenson, 1917, p. 88.

Chaetogaster annandalei Stephenson. Stephenson, 1918, p. 9; 1923, p. 9.
Chaetogaster langi Bretscher. Stephenson, 1922 b, p. 278; 1923, p. 50.

Prostomium fairly well developed, pointed, with long sensory hairs. Setae in II 4—8, in the other segments 3—7 per bundle. Transverse stomachal vessels 15—20. Cerebral ganglia with large hind lobes; a statocyst in the brain. Spermathecal ampulla elongate, vasa deferentia long, atrial ampulla fairly large. $n = 8$. $s = 10—16$. $l = 1—5$ mm.

Europe, India, China, N. and S. America.

Sweden: Lapland: Ylilombo (Almstedt, 1946); Långsjön, Metsjön, Trehörningen, ponds in Uppsala, Dalälven, Åkerö tjärn, Yttre Sörvattnet, Hällsjön, Storån, Foskan, several rivulets in Idre. In the vegetation at the edges.

The synonymy of the *Chaetogaster* species is fairly confused, as the older authors had no adequate conception of them. *Nais vermicularis* O. F. Müller probably was, or included the present species. The diagnosis given is the following: "Naidum minima oculisque difficulter conspicitur; licet enim quam reperi, prolifera esset, vix tamen duas lineas excessit. Caput subclavatum, absque oculis, subtus pilis, setis pedum, longioribus barbatum. Verruca pedum quinque vel sex setis instructae." The length given, about 4 mm, agrees well. The words "caput subclavatum" are suggestive, too. — It may, however, possibly have been *Ch. cristallinus* instead. Later authors, who used the name, only quoted Müller, Rösel (cf. p. 66), and others. d'Udekem (1855) renamed what he considered to be *N. vermicularis*, *Choetogaster Mülleri*. As Timm (1883, p. 154, foot-note) points out, this species is probably identical with *Ch. diastrophus*, though it is impossible to be sure, as the description is insufficient ("a peine visible à l'œil nu. Crochets peu nombreux à chaque faisceau et peu manifestement fourchus. Absence presque complète de spicules épidermiques sur les téguments, qui sont tous transparents. Vit librement dans l'eau douce. Vitellus blanc.").

Chaetogaster gulosus Leidy probably belongs here, as Galloway (1911) points out. It is 1 line (about 2 mm) long, $^1/_{140}$ in. (175 μ) broad, and whitish-transparent, with a large, triangular mouth, and a digitiform upper lip. The setae are 5—6 per bundle. Their length however, presents a difficulty, as it is given as $^1/_{133}$ in. (184 μ), which, if it is not a misprint, is an enormous length for such a small worm, and makes the identification with *Ch. diastrophus* impossible.

Chaetogaster punjabensis Stephenson is, as Chen (1940) points out, certainly *Ch. diastrophus*, though Stephenson himself (1923, p. 50) identifies it with *Ch. langi*; the same applies to his *Ch. langi* Bretscher of 1922.

Chen is also undoubtedly right in identifying *Chaetogaster annandalei* Stephenson with the present species. The prostomium is triangular, the setae are gently curved, with fine teeth, the distal one longer, and the nodulus proximal. The setae in II are 4—5, 70—90 μ long, in the other

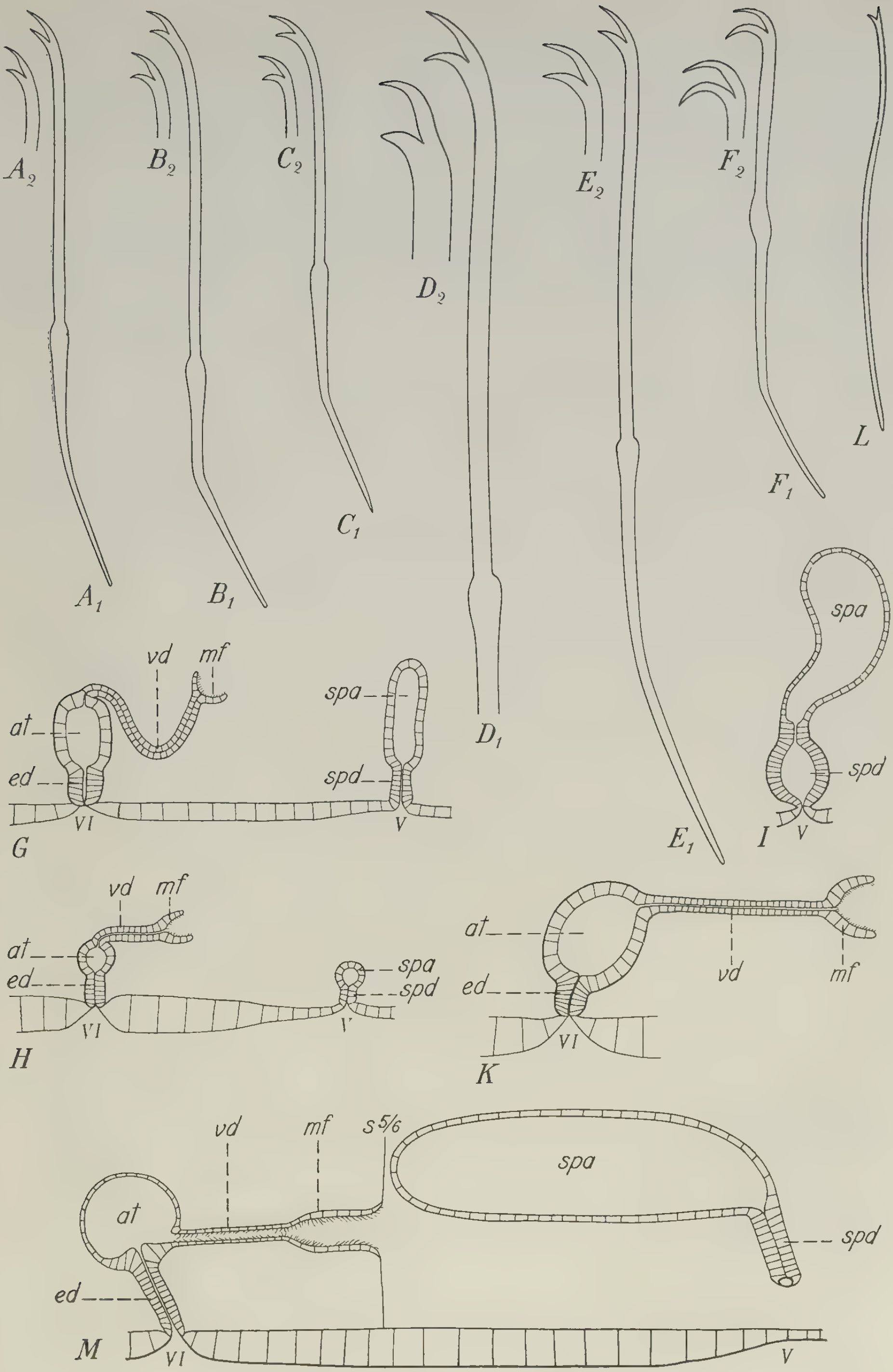
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Fig. 7. *A, B, G Chaetogaster diastrophus, C; H Ch. langi, D, I Ch. diaphanus, E, K Ch. cristallinus, F Ch. limnaei.* A_1-F_1 setae of VI, A_2-F_2 distal ends of setae of II, *G-K* genital organs. *L, M Amphichaeta sannio. L* seta, *M* genital organs. *A-F, L* 1200 ×, *G, H, K, M* 300 ×, *I* 150 ×. (Legends p. 290).

segments 2—3, 50—60 μ long, 1.5 μ thick. Everything thus agrees with my specimens of *Ch. diastrophus*; as CHEN remarks, the small size of the animals, and the absence of a refractile body in the brain will be due to the preservation.

The shape of a chain, about 5 mm long, is seen in Pl. I, fig. 1. The transverse vessels on the stomach leave the foremost part free. — The setae are unusually straight, with faintly curved teeth, and a fairly gentle, proximal curve (Fig. 7 A_1). Their length in II (Fig. 7 A_2) I found to be 72 –110 μ, in the following segments 57—81 μ (the extremes found in the literature are 70 –112 μ, and 42—81 μ respectively); the thickness was 1.6 μ and 1.4 μ respectively. The teeth in the hinder segments were about $\frac{4\ \mu}{2\ \mu}$.

The individuals found in Idre had a less acute prostomium, and setae in II thicker, 1.8 μ. The teeth in the hinder segments were about $\frac{3\ \mu}{2\ \mu}$ long (fig. 7 *B*). The number of stomachal ducts was slightly larger, about 20 against 15—17 in the others. The dorsal and ventral vessels in the pharyngeal region were unusually strong.

The sexual organs of *Choetogaster Mülleri* d'Udekem are described by D'UDEKEM (1861, p. 248, Pl., figs. 2—3). The spermathecae have a roundish ampulla, and a well-defined duct. The vasa deferentia are long, more than twice the length of an atrium with duct. The atria are large, oval, their longest diameter being about equal to the diameter of the spermathecal ampullae. Two penial setae are present. (According to PIGUET, 1906, *Ch. diastrophus* has 2—3 penial setae, about 70 μ long; he gives no account of the other sexual organs.) A small egg-sac is formed.

Three of my specimens of the Idre form had sexual organs, though not fully mature. The sexual organs are small, yet considerably larger than in *Ch. langi*. Testes and ovaries persist in one specimen; they are about 25 μ long and 15 μ broad, and are attached to the ventral nerve-cord. No oogonia, and spermiogonia I seem to be left, but a lump of oocytes, v. s. one of spermiogonia II, with mitosis posteriorly. — The empty spermathecal ampulla (Fig. 7 *G*) is about 50 μ high, and 18 μ in diameter, thus more lengthened than in D'UDEKEM's figure, the wall being 3 μ thick. The duct is about 20 μ long with a diameter of 11 μ. — The male funnels are small, widely open, 8 μ long, and 15 μ in diameter (Fig. 7 *G*). The length of the vasa deferentia is about 70 μ, the diameter 4.5 μ, and the wall is 1.5 μ thick (in life they are certainly somewhat longer, agreeing with "*Ch. Mülleri.*"). They join the atria at the top. The atrial ampulla is 35 μ high, 25 μ in diameter, and the wall is fairly thick, about 5 μ. The ejaculatory duct is 16 μ long and 16 μ thick. — No budding occurred in the mature specimens.

Chaetogaster palustris Pointner, 1914.

Chaetogaster palustris Pointner, 1914 b, pp. 272—273, Pl. XXVIII, figs. 2—3.
Chaetogaster palustris Pointner. Schuster, 1915, pp. 9, 58, 65. Ude, 1929, pp. 22—23.

Prostomium triangular. Sensory hairs extremely long on prostomium and pygidium, and, segmentally arranged, behind IV. Setae in II 4—6, in the rest 3—5 per bundle. No statocyst. $n = 9$. $s = 12$. l (simple specimens) = 0.6—1.7 mm, (chains) = 2.5—3.5 mm.

Central Europe.

This species is closely related to *Ch. diastrophus*, and might be suspected to represent only an aberration of the latter, with longer sensory hairs than usual (cf. Timm, 1883, p. 144, who found one specimen of *Ch. diaphanus* with segmentally arranged sensory hairs, partly as long as the diameter of the body. Schuster, 1915, p. 9, supposes Timm to have actually had *Ch. palustris* before him, but such a mistake seems hardly probable). The length of the sensory hairs in Pointner's figure is considerably exaggerated, being double the length of the setae of II, whereas the measurements given (up to 87—98 μ) indicate about the same length as these. The seta measurements are very much the same as in *Ch. diastrophus* — 72—122.5 μ in II, 45.5—80 μ in the rest — and the shape of the setae too (Pointner, 1914 b, Pl. XXVIII, fig. 3). The brain, however, is stated to be smaller than that of *Ch. diastrophus*, though obviously resembling it in shape, with large hind lobes; the statocyst is stated to be absent. If one may rely on the figure, the transverse stomachal ducts are about 24, which is much more than in *Ch. diastrophus*. — Further findings, with a careful examination of the setae, are required to make sure of the distinctions.

Chaetogaster langi Bretscher, 1896.

Fig. 7 *C*, *H*; Pl. I, fig. 2.

Chaetogaster langi Bretscher, 1896, pp. 512—513, Fig. 1.
Chaetogaster langi Bretscher. Bretscher, 1900, p. 18, Pl. I, fig. 15. Michaelsen, 1900, p. 21; 1909 a, p. 10. Munsterhjelm, 1905, p. 10. Piguet, 1906, pp. 202—203. Walton, 1906, p. 690. Galloway, 1911, p. 306. Piguet & Bretscher, 1913, pp. 21—22. Pointner, 1914 b, pp. 93—97. Schuster, 1915, pp. 8—9, 64. Svetlov, 1924, p. 189. Malevich, 1927, p. 5. Wolf, 1928, p. 387, Figs. 2—3. Ude, 1929, p. 23. Černosvitov, 1930, p. 9; 1938 b, pp. 268—269. Chen, 1940, pp. 32—33. Marcus, 1943, pp. 13—15, Pl. I, fig. 2.
Chaetogaster spongillae Annandale, 1906, p. 188, Fig. 1 A.
[?] *Chaetogaster sp.* Annandale, 1906, p. 189, Fig. 1 B.
[?] *Chaetogaster pellucidus* Walton, 1906, pp. 690—691, Fig. 4 A—D.
Chaetogaster spongillae Annandale. Stephenson, 1907 b, p. 248; 1911, p. 205, Fig. 1; 1923, pp. 52—53, Fig. 10. Marcus, 1943, p. 16, Pl. I, fig. 4.

[?] *Chaetogaster sp.* Annandale. Stephenson, 1907 b, p. 248; 1923, p. 53.
[?] *Chaetogaster pellucidus* Walton. Galloway, 1911, p. 306.
[*non*] *Chaetogaster langi* Bretscher. Stephenson, 1922 b, p. 278; 1923, p. 50.

Prostomium inconspicuous. Setae in II 3—9, in the rest 3—6 per bundle. Transverse stomachal ducts 8—10. A statocyst in the brain. Spermathecae small, with round ampulla; vasa deferentia short, straight; atria small, round; penial setae 2 per bundle. $n = 8—9$. $s = 8—21$. $l = 0.8—2$ mm.

Europe, Asia, Africa, N. and S. America. Found also in brackish water (the Baltic).

Sweden: Waters in Småland and Närke (Almstedt, 1946); Skedviken, Trehörningen, Siljan, Dalälven, Foskan, Övre Hågåsjön, Lilla Gladaviken, Rudtjärn, Vallsträsket, Kräkångersselet, Missjön, many ponds and lakelets.

As Chen (1940) points out, *Ch. spongillae* Annandale (1906) will belong here, as all characters fall within the limits for the present species. Marcus (1943, p. 16) rejects the synonymy on account of the shorter oesophagus in *Ch. spongillae.* As remarked above (p. 58), the length of the oesophagus cannot be used as a specific character here. I often found a very short oesophagus in *Ch. langi.*

Chaetogaster sp. Annandale, from India, may be *Ch. langi*, too. The brain is stated to contain "a sensory organ which is densely pigmented and probably functions as an eye" — apparently identical with the "refractile body" or statocyst. The pharynx is stated to be unusually short, the buccal cavity deep, and the vascular plexus well developed. The "clitellum," figured behind the eighth segment is no doubt a newly-formed zone of fission. The setae of II are stated to play no part in the locomotion, but are used "to seize and retain living prey" — an extraordinary statement, indeed, as it would be a very remarkable difference against the other *Chaetogaster*, and all other Naids, too (cf. p. 36). As A. states the same phenomenon in *Ch. bengalensis*, too, he has probably been mistaken in his observation.

Of *Ch. pellucidus* Walton, from N. America, too, insufficient characters are given. Walton states it to be most closely related to *Ch. limnaei*, but this is excluded on account of the form of the setae, which are slightly and evenly curved, with the distal tooth considerably longer than the proximal, suggestive of *Ch. diastrophus* or *langi* (op. cit., Fig. 4 C). The length of the setae, measured from the figure would be about 75—100 μ, but it is not stated whether they belong to segment II or to a posterior segment, though the latter does not seem probable, as they would be extremely long for so small an animal. It is, however, possible that the enlargement given is wrong, as the body-size of the animal as measured from the figure is about 3.8 mm, whereas it is stated to be 1.5 mm. Possibly the setae ought also to be about half the size, thus 38—50 μ, which is better for *Ch. langi.* — The number of stomachal ducts — 12 or more — is slightly too high for this species, but the variation may be greater than that found by me (8—10). Further investigation is needed.

The seta measurements of *Ch. langi* found in the literature are: in II 63—100 μ, in the rest 35—68 μ.

Pl. I, fig. 2 shows the appearance of a chain of *Ch. langi*, about 2 mm long. The transverse ducts of the stomachal plexus are not easily discernible. — The setae very much resemble those of *Ch. diastrophus*, but the teeth are somewhat more curved, and the proximal curve is more angular (Fig. 7 *C*, p. 61). (PIGUET, 1906, has the reverse opinion, which may be explained by the different appearance of the setae within a bundle; thus setae are easily found in *Ch. diastrophus* which are more abruptly bent than many setae in *Ch. langi*). I found the setae in II to be 4—6 per bundle, 70—90 μ long, 1.6 μ thick, those of the other segments 4—5 per bundle, 50—63 μ long, and only 1.1 μ thick.

I found sexual organs only twice. They are very small, though the worms are fully mature, containing each one large ovum. The spermathecae were empty, with round ampullae, 11 μ in diameter, and the duct about 8 μ long (Fig. 7 *H*, p. 61). The male funnels are cup-shaped, 15 μ long, with a diameter of 11 μ. The vasa deferentia are about 30 μ long, but fairly wide, 6.5 μ, with a wall thickness of 2.5 μ. The atria are round, the ampullae 15 μ in diameter, and the ejaculatory duct is about equally long. There are penial setae, the shape of which I could not make out. Probably they have the common shape, as PIGUET (1906, p. 203) reports them without any remark on their appearance. (He gives no description of the other sexual organs.) He found the longest to be 73 μ long; I found about 40 μ. — The sperm-formation does not seem to be so lively as in the larger species (cf. p. 45). No distinct sperm-sac and ovisac are formed (though MARCUS found small ones). A ripe ovum lay dorsally in VI. The mature specimens formed no buds.

Chaetogaster parvus Pointner, 1914.

Chaetogaster parvus POINTNER, 1914 a, pp. 606—607, Pl. XVIII, fig. 1.
Chaetogaster parvus Pointner. POINTNER, 1914 b, pp. 94, 96, 97. MARCUS, 1943, p. 15, Pl. I, fig. 3.

Opaque. Prostomium inconspicuous. Setae in II 4—6 per bundle, in the following segments 3—6. A pulsating "heart" in IV. n (counted on the figure) = 8. s = 10—12. l (simple individuals) = 0.5—0.8 mm, (chains) up to 1.2 mm.

Europe, S. America (Brazil).

The characteristics of this species are: its minute measurements which are, however, not very different from those of *Ch. langi* (the body-length 0.5—0.8 mm is stated to occur in specimens of 10—12 segments, in contrast to chains, and thus ought to apply to simple individuals, but on the other hand the species is said (POINTNER, 1914 b, p. 97) to have been found only budding); its reduced transparency (cf. p. 59); and a pulsating, heart-like dilatation stated to be found on the ventral vessel in IV, immediately behind the junction of the transverse vessels (POINTNER, 1914 a, p. 607, Pl. XVIII, fig. 1 H). As the ventral vessel is always non-contractile, this dilatation will belong to the transverse vessels, which have obviously fused a little before they join the ventral vessel. This is not in conflict with the figure, where the last part of the ventral vessel in front of the dilatation is omitted. The setae in II are stated to be 59.5—72.6 μ, the rest 41—45.5 μ. — In the specimens reported by MARCUS (1943) there was no pulsating dilatation, which might throw some doubt on the identification.

The species seems extremely doubtful, as there seem to be no constant characters separating it from *Ch. langi*. However, as two competent observers, who have examined living specimens, maintain that there is a difference, the species may be upheld provisionally, subject to further confirmation.

Chaetogaster diaphanus (Gruithuisen, 1828).

Figs. 5, 7 *D*, *I*; Pl. I, figs. 5, 6.

Das madenähnliche Schlänglein RÖSEL VON ROSENHOF, 1755, pp. 578—581, Pl. XCIII, figs. 1—7.

Nais vermicularis Müller. GMELIN, 1788—1793, p. 3120 [*partim*]; MODEER, 1798, pp. 118—120 [*? partim*]. LAMARCK, 1816, p. 223 [*partim*]. BLAINVILLE, 1825, p. 129 [*partim*]. TABL. ENC. MÉTH., 1827, p. 134, Pl. LII, figs. 1—7.

Nais diaphana GRUITHUISEN, 1828, pp. 409—416, Pl. XXV, figs. 1—5.

Chaetogaster niveus EHRENBERG, 1828, p. 109, foot-note.

Lurco PRITCHARD, 1832, pp. 78 ff., Pl. VIII, fig. 1.

Chaetogaster nivaeus Ehrenberg. GERVAIS, 1838, p. 15.

Nais diaphana et perversa Gruithuisen. GERVAIS, 1838, p. 15.

Blanonais vermicularis (Roesel). GERVAIS, 1838, p. 15.

Chaetogaster diaphanus (Gruithuisen). ØRSTED, 1842, pp. 138—140, Pl. III, figs. 2, 15—17 [*partim*]. LEYDIG, 1864, p. 10, Pl. III, figs. 6—7. LANKESTER, 1869 b, pp. 284—285, Pl. XV, figs. 5, 6, 8. TAUBER, 1873, pp. 384—398, Pl. XIII, figs. 8—20; 1879, p. 26. SEMPER, 1877, pp. 75—103, Pl. IV, figs. 1—8. VEJDOVSKY, 1883, p. 220; 1884, p. 37, Pl. V, Pl. VI, figs. 19—21. TIMM, 1883, p. 154. LEVINSEN, 1884, p. 216. VAILLANT, 1890, pp. 449—450. BEDDARD, 1895, pp. 306—307. BRETSCHER, 1896, p. 511. MICHAELSEN, 1900, p. 21; 1909 a, p. 10; 1926 a, p. 21; 1927, p. 7, Fig. 1. SMITH, 1900, p. 443; 1918, p. 638. DITLEVSEN, 1904, pp. 461—462, 471—472. MUNSTERHJELM, 1905, p. 10. PIGUET, 1906, pp. 203—205; 1919 a, pp. 789—790; 1928, p. 80. PIGUET & BRETSCHER, 1913, pp. 19—20. POINTNER, 1914 b, pp. 94—97. SCHUSTER, 1915, pp. 8, 62—63. EKMAN, 1915, pp. 147, 288. DEHORNE, 1916, pp. 35—75, Figs. 1—34. STEPHENSON, 1922 b, p. 279. SVETLOV, 1924, p. 190; 1926 b, pp. 360—372, Figs. 1—15. MALEVICH, 1927, p. 5. WOLF, 1928, p. 387. UDE, 1929, pp. 24—25, Fig. 19. CHEN, 1940, pp. 29—31.

Nais lurco JOHNSTON, 1845, p. 443.
Chaetogaster vermicularis Müller. GRUBE, 1851, p. 109 [*partim*].
Choetogaster diaphanus (Gruythuisen). D'UDEKEM, 1855, p. 553; 1856, pp. 50—53, 63, 64, 67, 70, Pl. III, figs. 10—16; 1859, p. 23.
Nais lacustris DALYELL, 1853, pp. 130—131, Pl. XVII, figs. 1—5.
Nais scotica JOHNSTON, 1865, pp. 71, 336.
[*non*] *Chaetogaster niveus* Ehrenberg. LANKESTER, 1869 a, p. 641, Pl. XLVIII, figs. 9—11.
Vetrovermis hyalinus IMHOF, 1888, pp. 48—49.
Chaetogaster pellucidus STEPHENSON, 1907 b, pp. 237—245, Figs. 2—6, Pl. IX, figs. 1—10.
Chaetogaster orientalis STEPHENSON, 1910 a, pp. 68—71, Fig. 4, Pl. VIII, figs. 3—4.
Chaetogaster orientalis Stephenson. STEPHENSON, 1922 c, pp. 109—118, Figs. 1—6; 1923, p. 51, Fig. 9.
Chaetogaster diaphanus (Gruithuisen) var. *cyclops* HAYDEN, 1922, p. 168.

Prostomium inconspicuous. Setae of II 6—13 per bundle, in the other segments 4—10. Stomachal plexus forming transverse ducts only anteriorly. A statocyst in the brain. Spermathecal ampulla large, roundish or pear-shaped, duct forcibly dilated before the opening; vasa deferentia short; atrial ampulla large, round. Penial setae 3—5 per bundle. $n = 9$—12. $s = 14$—15. $l = 2.5$—25 mm.

Europe, Asia, N. America. Found in brackish water also (the Baltic).

Sweden: Waters in Scania, Småland, Halland, Närke, Södermanland (ALMSTEDT, 1946); Lake Vättern (EKMAN, 1915); Lapland, Sarek: Lake Virihaure (N. VON HOFSTEN & G. ALM coll.; PIGUET, 1919); Båven (N. VON HOFSTEN coll.); Vettersöfjärden, Klintsundet (brackish; S. BOCK coll.); Sävsundet (brackish; I. ARWIDSSON coll.); Juvuln (S. RUNNSTRÖM coll.); Brunnsviken, Valloxen, Skedviken, Metsjön, Ekoln, Fyrisån, Trehörningen, Siljan, Hällsjön, Foskan, rivulet in Idre, Kräkångersfjärden (brackish), Lilla Gladaviken, Kyrksjön, Älgträsket, Vallsträsket, Degerträsket.

The older synonymy of this species, as that of the others, is fairly difficult (cf. *Ch. diastrophus*). — As PIGUET (1928), and CHEN (1940) have pointed out, *Chaetogaster orientalis* Stephenson (= *Ch. pellucidus* Stephenson) has to be ranged within this species.

The alimentary plexus on the stomach forms transverse ducts on the foremost part only; posteriorly it is plexiform (cf. VEJDOVSKY, 1884, Pl. V, figs. 1—2).

The setae are very much longer and stronger than in any of the other species. In II in one specimen I found them to be 145—270 μ long, 4.5 μ thick, with teeth $\frac{8\ \mu}{4.5\ \mu}$ (Fig. 7 *D*, p. 61); in the other segments they were 112—170 μ long, 2.5 μ thick, with teeth $\frac{7\ \mu}{5.5\ \mu}$ (Fig. 7 D_2). The teeth are more curved than usual, and the proximal flexation is abrupt and strong. The measurements found in the literature are: in II 156—350 μ, in the rest 105—210 μ.

The sexual organs of *Ch. diaphanus* have been described several times [D'UDEKEM, 1856, pp. 51—53, Pl. III, figs. 10—16; TAUBER, 1873, pp.

387—398, Pl. XIII, figs. 8—20; Vejdovsky, 1884, Pl. V, figs. 5—9; Dehorne, 1916, pp. 68—75, Figs. 33—34; Stephenson, 1910 a, pp. 69—71, Fig. 4, Pl. VIII, fig. 3 (*Ch. orientalis*) and others], but no measurements are given, so I will give those I have found. (For testes and ovaries see pp. 43—45, Fig. 5.) — The spermathecae, when filled, are roundish or bag-like, narrowing towards the duct (Fig. 7 *I*). The ampulla is 145—235 μ long, and 60—140 μ in diameter. The duct is about 80 μ long, with an outer diameter of 30 μ, except above the opening, where it may be strongly dilated, with a diameter of 55 μ. The wall thickness of the ampulla varies greatly with the state of filling; the wall of the duct is about 15 μ thick, consisting of columnar epithelium. The male funnels are large, cup-shaped. Their length is about 35 μ, the diameter 85 μ, the wall-thickness 10—15 μ. The vasa deferentia are about 160 μ long, with a diameter of 20 μ, and a wall thickness of 6—7 μ. They join the atria at the top, which is directed forwards (Pl. I, fig. 6). The atria are large, the ampulla roundish, length, breadth, and height being about 185 μ, 120 μ, 100 μ respectively, with glandular walls (cf. p. 50), 3—11 μ thick. The muscular coat is thin. The ductus ejaculatorius is about 80—90 μ long, and as thick, the wall thickness being 35—40 μ. There are usually 3 penial setae, about 100 μ long, and 3 μ thick, with a slight nodular swelling at about 1/4 of the length from the distal end. This may be simple, or provided with a short distal tooth.

The female funnels are situated laterally, hindmost in VI.

Chaetogaster cristallinus Vejdovsky, 1883.

Fig. 7 *E*, *K*; Pl. I, fig. 3, Pl. II, figs. 1–3.

Chaetogaster Mülleri d'Udekem. Tauber, 1879, p. 76.
[*?*] *Chaetogaster niveus* Ehrenberg. Lankester, 1869 a, p. 641, Pl. XLVIII, figs. 9—11.
Chaetogaster cristallinus Vejdovsky, 1883, p. 220.
Chaetogaster cristallinus Vejdovsky. Vejdovsky, 1884, p. 37, Pl. VI, figs. 1—10. Vaillant, 1890, p. 450. Beddard, 1895, p. 307. Bretscher, 1896, p. 511.
Chaetogaster crystallinus Vejdovsky. Michaelsen, 1900, p. 21; 1909 a, p. 10. Munsterhjelm, 1905, p. 10. Piguet, 1906, p. 203. Southern, 1909, p. 132. Piguet & Bretscher, 1913, p. 21. Pointner, 1914 b, p. 96. Schuster, 1915, pp. 9, 64. Stephenson, 1922 b, pp. 278—279; 1932, p. 229. Svetlov, 1924, p. 190. Wolf, 1928, pp. 386—387. Ude, 1929, p. 23.
Chaetogaster sp. Svetlov, 1924, p. 190.

Prostomium inconspicuous, with a median incision. Setae in II 4—13 per bundle, in the rest 4—6. Transverse stomachal ducts 20—22. A statocyst in the brain. Spermathecae with large ampulla and short duct; vasa deferentia long, narrow, straight; atrial ampulla round, duct short; penial setae 2 per bundle; a small ovisac formed in VII. $n = 8—9$. $l = 2.5—7$ mm.

Europe, Asia (Baical), Africa (Abyssinia). Found also in brackish water (Finland).

Sweden: Pond in Karlsborg, Valloxen, Trehörningen, Siljan, Åkerö tjärn, Hällsjön, Övre Hågåsjön, Yttre Sörvattnet, Foskan, ponds and rivulets in Idre, Vallsträsket, Kräkångersselet, Missjön.

It is probable that this species was formerly confused with the other species, and quoted under various names (cf. the synonym lists of *Ch. diastrophus* and *diaphanus*). — *Chaetogaster Mülleri* d'Udekem of TAUBER is certainly the present species, for he writes: "The asexual form I cannot keep apart from young specimens of *Ch. diaphanus*" (transl.). — *Chaetogaster niveus* Ehrenberg, LANKESTER (1869 a), may be this species. The body-length, (about 3 mm) and the length of the setae (much longer than those of *Chaetogaster limnaei*, especially those of II being very long), which are about 8 per bundle (at least in the posterior segments), make this identification the only possible one among known species. It is, however, figured without any incision in the prostomium (op. cit., Pl. XLVIII, fig. 9), but this does, of course, not exclude the existence of one. — *Chaetogaster sp.* Svetlov is described as follows (transl.): "Prostomium not developed. Transparent. Upper tooth of the setae longer than the lower. Setae in segm. II 140 μ long, in the following 108 μ. Oesophagus distinct, pharynx short. Circulatory system in the pharynx region well developed. Cerebral ganglion with an incision posteriorly and anteriorly." SVETLOV writes that this is a mixture of the characters of different species and throws up the possibility of a hybrid between *Ch. diastrophus* and *Ch. cristallinus*. This is, however, not necessary, the only difference from *Ch. cristallinus* being the well-developed pharyngeal vessels, and, as POINTNER (1914 b) remarks, this character is not constant. SVETLOV found his form only in one locality, where the common form did not occur, so it may well be a local form of *Ch. cristallinus*.

The incision in the middle of the frontal contour of the prostomium seems to be a non-failing character of this species, though it is often fairly difficult to observe. (Unfortunately, it is not seen in Pl. I, fig. 3, which presents a side-view of the animal.)

The conditions of the blood-vessels about the pharynx may vary (cf. above). As a rule, they are rudimentary, as stated by VEJDOVSKY, but, as POINTNER points out, they may also be fully developed (according to him they are sometimes faintly or not developed in *Ch. diaphanus*, *Ch. langi*, and *Ch. diastrophus*, too). In mature specimens I found them well developed. The dorsal vessel, after piercing septum 3/4, joins the pharynx wall, and divides below the brain, the branches accompanying the pharyngeal connectives, joining each other at the same point as the latter. The ventral vessel detaches itself from the nerve-cord a little in front of septum 3/4. It is quite the same picture as in *Chaetogaster diaphanus* (cf. VEJDOVSKY, 1884, Pl. V, fig. 1).

The commissure between the pharyngeal ganglia is several times as long as in VEJDOVSKY's figure (op. cit., Pl. VI, fig. 2). The cerebral ganglia are much stronger than in this figure, leaving a fairly deep incision between them behind, and a faint one anteriorly (cf. above on *Ch. sp.* Svetlov).

The setae are much shorter and finer than in *Ch. diaphanus* (Fig. 7 *E*, p. 61). They are, as a rule, 8—9 in II, 4—6 in the rest. The thickness is 1.7 μ and 1.5 μ respectively, the teeth being about $\frac{6\ \mu}{4.8\ \mu}$ and $\frac{5\ \mu}{3.5\ \mu}$. The length of the setae in one specimen was, in II 111—160 μ, in the other segments 96—110 μ, in another it was 108—144 μ, and 88—96 μ, respectively, which makes the difference between the two sorts greater, which is more usual. The extreme of this difference was represented by a specimen, where the setae of II, 5—6 per bundle, were 119—159 μ long, those of the rest 82—85 μ, 3—4 per bundle.

The measurements found in the literature are: in II 122.5—165 μ, in the rest 81—130 μ.

The sexual organs of this species have not been described before. They are much smaller than those of *Ch. diaphanus.*

The clitellum is quite short, as in *Ch. diaphanus.* It extends over 1/2 V—VI only, and is absent between the male pores.

The testes (cf. p. 43) are found only at a very early stage. They are attached to the posterior side of septum 4/5, and to the ventral nerve-cord. They are fairly irregular, about 25 μ high, 20 μ broad, and 35 μ long, and are continued backwards by scattered spermiocyte aggregates. The diameter of the spermiogonia is about 8 μ.

The ovaries (cf. p. 45) are in the same manner attached to the ventral nerve-cord and septum 5/6. They consist of a quite small, anterior part, about 20 μ long and broad, and 12 μ high, with oogonia, about 8 μ in diameter, with a large nucleus, and, later, a larger, posterior and more lateral part, which represents obviously the "stage of growth" (cf. STEPHENSON, 1930, p. 459). The oocytes grow a good deal in this situation, so that in different specimens they may be unequally large, and even in the same specimen the different sides may show different stages (cf. Pl. II, figs. 1, 2). Thus, the oocytes may be 4.5—17 μ in diameter, with nuclei up to 8—14 μ, and nucleoli 3 μ. The whole formation may attain measurements of 30—50 μ in length, 20—40 μ in breadth and height. The ovaries persist much longer than the testes.

The spermathecae, when still empty, are small and spherical, but when filled with sperm they are much distended (in one specimen 60 μ × 44 μ × 47 μ) and at last lengthened, as in *Ch. diaphanus*, obtaining a length of 160 μ, and a diameter of 40 μ × 50 μ. (Pl. I, figs 7, 8.) The wall is then only 2 μ thick. The spermathecal duct is well defined, 30 μ long, 17 μ in diameter, with the wall 8.5 μ thick; there is no dilatation (Pl. I, fig. 7).

The male funnels are more cup-shaped, and less open than those of *Ch. diaphanus*, the length and the diameter being alike, about 30 μ (Pl. I, fig. 8). Their wall thickness is 6—9 μ. They are strongly ciliated.

The vasa deferentia run directly backwards. They are very thin, 7—8 μ, with a wall thickness of 2.5 μ. Their length in preserved material is 65—85 μ, but in living specimens they are, when stretched, much longer, 125—130 μ.

The atria are slightly bent forwards, spherical or faintly oblong in living specimens (Fig. 7 *K*, p. 61); on fixation, when the animal contracts itself, they are often flattened by the stomach (Pl. II, fig. 2). The measurements in one specimen were: height 50 μ, diameter 40 μ × 44 μ. Thus, the vasa deferentia are a good deal longer in relation to the size of the atria, than in *Ch. diaphanus* (cf. p. 68). The ejaculatory ducts are relatively shorter than in this species, about 20 μ; this is especially conspicuous in living specimens.

The penial setae, 2 per bundle, 53—69 μ long, have the common appearance, with a simple hook (Pl. II, fig. 2). I have seen none with an extra tooth. The nodulus is not well defined. It is situated about 1/4 of the setal length from the tip.

As usual no sperm-sac is formed. The smaller oocyte-aggregates also slip through the septa, but as a rule they seem to have grown so much before detaching themselves, that they collect in VI, by and by pressing against septum 6/7, which bulges back-wards, so that a small ovisac is formed.

This species, as the other *Chaetogaster* I have found mature, developed its sexual organs during the late part of July, and August. It is fairly common in Sweden.

Chaetogaster setosus Svetlov, 1925.

Chaetogaster setosus Svetlov, 1925, pp. 473—474, Pl. I, figs. 1—2.
Chaetogaster setosus Svetlov. Lastočkin, 1937, p. 233.

Prostomium reduced. Setae simple-pointed, curved distally; those of II 9—10 per bundle, with nodulus 1/3 from the proximal end, in the following segments 5—8 per bundle, without a nodulus. Oesophagus well developed. Brain with a deep median incision in the hind border. $s = 13$. $l = 0.66$ mm.

Russia.

As Svetlov points out, the characteristics of this species are the numerous, unusually long, simple-pointed setae (it is not known, which of the teeth persists). He compares them to the similarly developed ventral setae of II—V in *Nais behningi* (cf. p. 120), which were assumed by MICHAELSEN (1923) to serve as attaching organs in rapidly streaming water.

The setae in II are stated to be 105—113 μ long, 2.5 μ thick, in the remainder 77—115 μ long, 1.5 μ thick.

Chaetogaster krasnopolskiae Lastočkin.

Chaetogaster krasnopolskiae Lastočkin. LASTOČKIN, 1937, p. 233.

Setae with reduced distal tooth. Oesophagus well developed. No blood-vessels on the pharynx; dorsal and ventral vessel uniting in IV. No statocyst in the brain. $n = 8$. $l = 1.2$—1.4 mm.
Russia.

A short and fairly unsatisfactory description of this species is given by LASTOČKIN (1937), but the original description seems to have occurred in some Russian paper, to which I have not had access.

The setae are stated to be 60 μ long in II, at least 51 μ in the remainder.

The reduction of the distal tooth of the setae, and of the vascular system, are remarkable characteristics of this species. — In the description it is stated that the vascular ring in the oesophageal segment is absent, the ventral vessel passing directly into the dorsal vessel; it seems more probable that one of the transverse vessels persists.

The length of the oesophagus is stated to be 1/2 of the pharyngeal length.

Chaetogaster limnaei von Baer, 1827.

Prostomium vestigial. Setae usually numerous, with strongly hooked teeth. Oesophagus very short. Commensal on pulmonates.

The group of *Chaetogaster* living on snails are so similar to each other, and so sharply marked off from the rest of the genus in anatomical characters (the inconspicuous oesophagus and the peculiar shape of the setae, cf. p. 9), that their position ought to be stressed in some way. It seems very probable that they form a "Rassenkreis" of geographical and possibly partly ecological races. *Ch. limnaei* is found in Europe, N. America, and Japan, and *Ch. bengalensis* in British India and Burma. CHEN reports both forms from China, but they do not seem to be distinct here, so presumably China represents an area of transition between the two races. *Ch. victoriensis* and *Ch. australis* are both found in Australia, but apparently in different hosts. Therefore I have made them subspecies of *Ch. limnaei*; it may, of course, also be that some of them are independent species, and the whole complex an "Artenkreis" — in that case the erection of a subgenus would be convenient.

Chaetogaster limnaei limnaei von Baer, 1827.

Fig. 3 *A*, *B*, 7 *F*; Pl. I, fig. 4.

Chaetogaster Limnaei von Baer, 1827, pp. 611—615, Pl. XXX, figs. 23—24.
Chaetogaster furcatus Ehrenberg, 1828, p. 109, foot-note.
Nais vermicularis ? Müller. Dugès, 1837, pp. 30—31, Pl. I, figs. 21—23.
Chaetogaster Linnaei Baer. Gervais, 1838, p. 15.
Chaetogaster furcatus Ehrenberg. Gervais, 1838, p. 15.
Mutzia heterodactyla Agassiz. Vogt, 1841, pp. 36—38, Pl. II, figs. 13—15.
Gordius inquilinus Müller. Gould 1841, p. 213.
Chaetogaster diaphanus (Gruithuisen) [*partim*]. Ørsted, 1842, pp. 138—140, Pl. III, figs. 2, 15—17.
Chaetogaster vermicularis Müller [*partim*]. Grube, 1851, p. 105.
Choetogaster Linnaei Baer. d'Udekem, 1855, p. 554.
Choetogaster Limnaei Baer. d'Udekem, 1859, p. 24.
Chaetogaster limnaei Baer. Lankester, 1869 a, pp. 631—641, Pl. XLVIII, figs. 1—3, 12—13, Pl. XLIX, figs. 14—15, 17—27, 29—37; 1869 b, pp. 272—285, Pl. XIV, Pl. XV, figs. 1—8; 1869 c, pp. 102—104; 1871, pp. 99—101. Tauber, 1873, pp. 399—402, Pl. XIII, figs. 1—7; 1879, p. 76. Timm, 1883, p. 154. Vejdovsky, 1883, p. 220; 1884, p. 36, Pl. VI, figs. 16—18. Levinsen, 1884, p. 216. Beddard, 1895, p. 306. Bretscher, 1896, p. 511. Michaelsen, 1900, p. 22; 1903 b, p. 172; 1909 a, p. 11, Figs. 12—13; 1909 b, p. 131; 1926 a, p. 21; 1927, p. 8, Fig. 2. Smith, 1900, p. 443; 1918, p. 638. Willcox, 1901, pp. 905—909. Levander, 1901, p. 12. Moore, 1905 a, p. 169. Piguet, 1906, pp. 205—206. Piguet & Bretscher, 1913, pp. 20—21. Schuster, 1915, pp. 7, 64—65. Stephenson, 1923, pp. 50—51. Svetlov, 1924, p. 190. Wolf, 1928, p. 388. Kondô, 1936, p. 383, Pl. XXIII, fig. 3. Chen, 1940, pp. 28—29.
Chaetogaster Limnaeae Baer. Vaillant, 1890, pp. 447—448, Pl. XXII, figs. 24—25.
[?] *Chaetogaster limnaei* ? Baer. Stephenson, 1918, pp. 9—10.

Setae of II 5—20 per bundle, in the following segments 4—20. Intestinal plexus on the stomach forming an irregular net-work. No statocyst in the brain. Spermathecae with long duct; atria small, elongated; penial setae with a double hook. $n = 8—9$. $s = 13$. $l = 1.2—5$ mm.

Europe, Asia, N. America. Found also in brackish water (Finland).

Sweden: Waters in Närke (Almstedt, 1946). Ponds in Uppsala (in several species of *Limnaea* and *Planorbis*, *Bithynia tentaculata*).

Pl. I, fig. 4 gives a complete view of the animal.

All forms living in snails have the setae arranged in a strong semi-circle, and the shape is also the same, with a proximal curve and long, parallel teeth at right angles to the shaft of the seta (Fig. 7 *F*). Apparently the form is an adaptation to the mode of life of the animals. The thickness of the setae in the present form I found to be about 2 μ in II, 1.5 μ in the rest. The length of the teeth was about $\frac{6.5\ \mu}{6.5\ \mu}$ and $\frac{4.5\ \mu}{4.8\ \mu}$ respectively. The nodulus is more distal than in the preceding species. Piguet (1906) found 2 (or 3) types differing in respect of the length and number of setae, and living in different host species. SCHUSTER (1915) met with the different types in respect of the setal number, but found the length not to be correlated with the number. In fact, the conditions seem to be extremely varying. A number of about 8—11 setae seems to be the most common, the higher extremes being rare. (For setal length see *Ch. l. bengalensis.*)

The genital organs were found by LANKESTER (1869 b), and TAUBER (1873). The description of the former is unsatisfactory; according to the latter the spermathecae are very long, the vasa deferentia thin, and the atria longish, with fairly long ducts (op. cit., Pl. XIII, fig. 1). The penial setae had 2 teeth. According to LANKESTER four penial setae were present on each side, of the usual appearance, with a simple hook. L. states, that the setae of mature specimens were much longer than in immature (more than $^1/_{100}$ in. = 245 μ in all segments, against about 110 μ in II, 60 μ in the rest) and much more numerous (20—30 against 12 in II, 16 against 8 in the rest). VEJDOVSKY (1884) found no differences in this respect.

Chaetogaster limnaei bengalensis Annandale, 1905.

Chaetogaster bengalensis ANNANDALE, 1905, pp. 117—120, Pl. III.
Chaetogaster bengalensis Annandale. STEPHENSON, 1918, pp. 10—11; 1920, p. 195; 1923, pp. 49—50. CHEN, 1940, pp. 26—28, Fig. 3.

Setae 11—20 in all bundles. Vascular plexus on the stomach forming transverse and longitudinal ducts (?). A statocyst in the brain. $n = 9—11$. $l = 8—10$ mm. Asia.

The differences between this subspecies and the preceding are not very clear. According to the literature, it seems that they differ in the following respects: 1) The body-size is greater in *Ch. l. bengalensis*; (8—10 mm against 1.2—5 mm); 2) The average length of the setae is greater in *Ch. l. bengalensis* (85—122 μ against 52.5—122.5 μ in II, 60—77 μ against 42.2—84.4 μ in the rest); 3) The number of setae per bundle is higher in *Ch. l. bengalensis* (11—20, mostly 15—17 against 4—20, mostly 8—11); 4) A statocyst is present in *Ch. l. bengalensis*, but not in *Ch. l. limnaei;* 5) The vascular plexus on the stomach forms a regular net-work with rectangular spaces in *Ch. l. bengalensis*, an irregular net-work in *Ch. l. limnaei*. This is not expressly stated for *Ch. l. bengalensis*, but STEPHENSON (1920, 1923) writes that the chloragogen cells are arranged like paving-stones, with linear intervals between them, and this can hardly be interpreted otherwise. — CHEN (1940) who reports both forms in China, and *Ch. l. limnaei* in America, suggests that the size of *n* would constitute the only real difference, being 8 in *Ch. limnaei*, and 9—10 in *Ch. bengalensis*. In the diagnosis of the former he gives, however, $n = 9$, and 8—9 is the figure found by others.

Then there would be no difference at all, and his forms would be identical (cf. above).

Stephenson states that a ring of cells is hanging into the lumen of the "crop" round the opening of the oesophagus; this is the case in *Ch. l. limnaei*, too.

Chaetogaster limnaei australis Davies, 1913.

Chaetogaster australis Davies, 1913, pp. 89—94, Pl. IX, figs. 1, 4, 6, 7 a, 8—16.

Setae 8—11 per bundle, with long teeth. Nephridia with a large dilatation, and a diverticulum before the opening. $n = 8$—11. $l = 0.88$—1.83 mm.
Australia. (In *Limnaea, Planorbis, Isidora.*)

This form seems to resemble closely *Ch. l. limnaei*. No seta measurements are given, and it is not stated if there is a statocyst in the brain, nor how the stomachal vessels are arranged. In the description I can find only one character distinguishing it from *Ch. l. limnaei*, namely the distal dilatation of the nephridia, which is stated to be large, and provided with a diverticulum (op. cit., Pl. IX, fig. 7 a). In *Ch. l. limnaei* the dilatation is very slight, only about twice the diameter of the tube.

Chaetogaster limnaei victoriensis Davies, 1913.

Chaetogaster victoriensis Davies, 1913, pp. 94—97, Pl. IX, figs. 2—3, 5, 7 b.

Setae 5—9 per bundle, those of II longer than the rest, all with short, parallel teeth, and nodulus median or slightly distal. $n = 8$. $l = 6$—9 mm.
Australia. (In *Isidora texturata.*)

This subspecies is also inadequately described, no measurements of setae being given, and no hints as to the shape of the stomachal net-work, nor to the existence or non-existence of a statocyst. The teeth of the setae seem to be unusually short. In respect of body-size it comes next to *Ch. l. bengalensis*, but it has much fewer setae.

*

Within the genus *Chaetogaster* several groups can be distinguished. The species *diastrophus* and *palustris* form one group, characterized by a well-developed prostomium, and a supra-oesophageal ganglion with large posterior lobes, characters which are generally recognized as primitive for the genus. The other species all have a strongly reduced prostomium and a simplified brain, the lobation being hardly perceptible. Among these, *Ch. limnaei* (with 4 subspecies) deviates, as stressed before (p. 58), strongly in the shape of its setae, oesophagus, and habits. — The two species *Ch. setosus* and *Ch. krasnopolskiae* both show reduction of one tooth of the setae, but their relations seem obscure. In the latter species the vascular system is stated to be strongly reduced, as is usually the case in *Ch. cristallinus*, (and, occasionally, in other species, cf. p. 69). It is hardly possible, as yet, to form an opinion of the relationships between these species and the rest, including *Ch. diaphanus*, *cristallinus*, *langi*, and *parvus*. The four latter species resemble each other very much, with chiefly such differences as are connected with the great differences in size between *Ch. diaphanus*, and, to a less degree, *Ch. cristallinus*, on one side, and *Ch. langi* and *Ch. parvus* on the other.

Genus **Amphichaeta** Tauber, 1879.

Generic type: *Amphichaeta leydigii* Tauber, 1879.

Prostomium well developed. Dorsal setae from III onwards; ventral setae in all segments from II onwards; all setae double-pronged crotchets. Septa well developed. Oesophagus in IV and part of V, its hinder part thickened; stomach in V—VI; intestine dilated in VII. No transverse commissural vessels. Nephridia sometimes packed against the ventral vessel. Cerebral ganglia fused anteriorly, with two long posterior lobes. Clitellum in V—VI; male funnels in VI, opening into V; vasa deferentia straight, joining atria at lower part of anterior face; no penial setae; sperm-sac and ovisac formed. No budding during maturity.

Amphichaeta leydigii Tauber, 1879.

Amphichaeta Leydigii Tauber, 1879, p. 76.

Amphichaeta leydigii Tauber. Vaillant, 1890, pp. 443—444. Beddard, 1895, p. 304. Michaelsen, 1900, p. 20.

Amphichaeta leydigi Tauber. Kowalewski, 1910, pp. 804—805; 1917 a, pp. 39—46, Figs. 1—3; 1917 b, pp. 77—79, Figs. 1—3. Michaelsen, 1926 b, pp. 257—260 [*partim*]; 1927 a, p. 8 [*partim*]. Wolf, 1928, pp. 385—386, Fig. 1. Piguet, 1928, pp. 79—80. Ude, 1929, p. 25 [*partim*].

Amphichaeta sp. Golanski, 1911.

Amphichaeta sannio var. *multisetosa* Lastočkin, 1924 a, pp. 14—16.

Setae of II 4 per bundle; in III dorsal setae usually 5, ventral ones 4 per bundle; in IV and V usually 2 per bundle; in the other segments most often 4, occasionally 1—3 per bundle. No vascular loop in the prostomium. Nephridia mostly paired, not connected with the ventral vessel, opening immediately in front of the ventral setae. Spermathecal ampulla tubular, duct indistinct; proximal part of the atrial ampulla bag-like, distal part tubular; vasa deferentia joining atria above atrial duct; atrial duct indistinct, with very wide lumen. $n = 9—11$. $s = 13—14$. l (mature specimens) = up to 1.7 mm, (chains) = up to 4 mm.

Europe. Fresh water.

Amphichaeta sannio Kallstenius, 1892.

Fig. 7 *L*, *M*; Pl. II, figs. 4, 5.

Amphichaeta sannio Kallstenius, 1892, pp. 42—53, Figs. 1—5.

Amphichaeta sannio Kallstenius. Beddard, 1895, p. 304. Michaelsen, 1900, p. 20. Kowalewski, 1917 a, pp. 79—80; 1917 b, pp. 47—48.
Amphichaeta leydigi Tauber. Michaelsen, 1926 b, pp. 257—260 [*partim*]; 1927 a, p. 8 [*partim*]. Ude, 1929, p. 25 [*partim*]. Knöllner, 1935, pp. 428—429.
[*?*] *Amphichaeta sannio* Kallstenius. Lastočkin, 1924 a, p. 14.

Ventral setae of II usually 4 per bundle; dorsal setae of III 4 per bundle; other setae usually 3 per bundle. Left branch of the ventral vessel making a loop into the prostomium. Nephridia frequently unpaired, closely connected with the ventral vessel, opening far in front of the ventral setae. Spermathecal ampulla globular or baglike, spermathecal duct distinct; vasa deferentia joining atria above the male duct; atria globular, atrial duct distinct, with narrow lumen. $n = 9$. $s = 9$. l (the first zooid of a chain) = 1.5 mm.

Europe. In brackish water (mostly?).

Sweden: The harbour of Västervik (Kallstenius, 1892); Stora Gladaviken.

The synonymy of the genus *Amphichaeta* has been fairly confused. Tauber's original description is very brief: "*Amphichaeta*, n. g. Praestomium dilatatum. Os inferum. Fasciculi uncinorum tam dorsalium quam ventralium. *Leydigii*, n. sp. Surcularis, minuta et diaphana. Par primum uncinorum seta modo unica, sequentium, 2—4." He found them in the rivulet Ladegaardsaaen, and they were, as he remarks (transl.) "all in so young budding stages, that a full specific diagnosis does not permit itself to be made." — (The references to Leydig's Lehrbuch der Histologie, and to the work of the same author in Arch. mikr. Anat., 1865, are erroneous — both unmistakeably deal with *Chaetogaster*.)

When Kallstenius later found an *Amphichaeta* in the brackish water of the Baltic, he dared not identify it with *A. leydigii*, but gave it, until further facts should be known, the new name of *A. sannio*. He gives a detailed description (though without measurements) and I, having reexamined his material, can give full support to all his statements, except for the number of setae, which is not always so constant as he states. As Kallstenius' paper is probably not easily obtainable, I give below a full account of the anatomy of his specimens, with measurements, especially of the setae and the sexual organs, which were treated only superficially by K.

The prostomium is usually very distinct, and pointed, though in preserved specimens it may be inconspicuous.

The setae are 42—52 μ long in all segments, very slender, about 1.3 μ thick (Fig. 7 *L*, p. 61). The teeth of the more median setae of a bundle are about $\frac{3\ \mu}{2\ \mu}$; in the lateral setae they are, as usual, more equal in length. There are 4 setae per bundle in II, and dorsally in III (according to K. ventrally in III, too, but I always found 3 here), usually 3 in the rest, but occasionally 2.

The pharynx is long, though in sections it usually appears shorter and straighter than in K.'s Fig. 1, more like that of a *Chaetogaster*. The oesophagus is of average length, its hind half greatly thickened, and strongly ciliated. It occupies IV, its thick part being situated partly in V (Pl. II, fig. 5). It passes without a constriction into the stomach, "der vordere Magendarm" which occupies the best part of V and VI. Its wall consists of large, flattened cells, as in *Chaetogaster* (cf. p. 29), and is strongly ciliated (Pl. II, figs. 4, 5). The intestine, which is dilated in VII ("der hintere Magendarm"), in its greater part has a thick wall of large cells, often projecting into the lumen, as in *Chaetogaster*. They also contain yellow granules, as in that genus (cf. p. 33). There is a fairly well developed chloragogen layer on the stomach and intestine.

The vascular system is extremely simple, consisting of only dorsal and ventral vessel and intestinal plexus, which is connected in VII—IX with the ventral vessel through one short vessel per segment. The left branch of the ventral vessel makes a convolution in the prostomium.

The nephridia, of the closed *Chaetogaster* type, begin in VII. They are often unpaired, and for the greater part of their length they are attached to the ventral vessel, the nephridial mass enclosing it, and mostly tightly pressed against it. The external apertures of the nephridia are situated a little in front of the middle of the segment, and fairly far in front of the ventral setal bundles.

The brain is situated very far forwards, over the mouth. It has two very long posterior lobes, but only one, median, pointed, anterior lobe, which is, however, stated by KALLSTENIUS to consist of two lobes, uniting during the development. The ventral nerve-cord is not exactly of the step-ladder type, but it is clearly seen to be double in the anterior segments, the muscles from the pharynx to the body-wall piercing it frequently, leaving only narrow commissures between them. The supra-pharyngeal ganglia are situated considerably farther backwards than in K.'s Fig. 1, near the middle of the pharynx.

The clitellum is short, as in *Chaetogaster*, including only the hinder part of V, and VI, and extending slightly into VII.

The testes (Pl. II, fig. 4 *t*) are situated immediately behind septum 4/5, attached to it and to the nerve-cord. They are a little flattened, about 50 μ × 40 μ × 25 μ. The spermiogonia are about 4.5 μ × 6 μ. The ovary (I can only find one, and this probably does not represent the initial stage, with oogonia attached to the septum, but a later one, with only oocytes, the other ovary having already disappeared) is situated behind 5/6 (Pl. II, fig. 4 *ov*). It is longish, 50 μ × 32 μ × 10 μ, the cells being about 8 μ in diameter. Owing to the age of the preparations, it is not possible to make out the appearance of the sexual cells. Both testes and ovaries disappear soon.

The spermathecae have a very distinct duct (Pl. II, fig. 5 *spd*) about 30 μ long, 14 μ in diameter, its walls being 7 μ thick, thus leaving only a very narrow lumen. It opens more laterally than the atrial duct (Fig. 7 *M*, p. 61). The ampulla, when empty, is globular (Pl. II, fig. 5 *spa*); when filled with sperm it resembles a long bag, its length amounting to as much as 180 μ, with a diameter of 50 μ. It then reaches as far back as to the funnels (Fig. 7 *M*).

The funnels are big, regularly clock-shaped, with a length of 40 μ, a diameter of 18 μ, and a wall thickness of about 3 μ. They lie wholly in VI, being attached to septum 5/6 with their borders, and facing almost straight forwards into V (Fig. 7 *M*, Pl. II, fig. 5 *mf*).

The vasa deferentia are short and straight, about 50 μ long, 8—9 μ in diameter, the wall thickness being 2 μ. They join the atria at a short distance above the opening of the atrial duct (Pl. II, fig. 5, Fig. 7 *M*). The atria (Pl. II, fig. 5) are approximately globular, their height, when they are filled with sperm, being about 50 μ, the other diameters about 40 μ. The wall is thin, about 2 μ, except round the opening of the ejaculatory duct, where it is much thicker, and appears to be glandular. — The duct is sharply distinct, 30 μ long, and about 10 μ in diameter, its walls being 4 μ thick, and the lumen thus fairly narrow.

The female funnels are inconspicuous, situated immediately in front of septum 6/7.

There is a sperm-sac and an egg-sac, the septa being far less reduced than in *Chaetogaster*. The sperm-sac extends into VII, the egg-sac into VIII.

I have also found a few specimens in a bay of the gulf of Bothnia, Stora Gladaviken in Lövånger, Västerbotten. They conform wholly with KALLSTENIUS' specimens. The setae were: in II 4 per bundle, about 45 μ long, dorsally in III 4 per bundle, 51 μ long, in the rest mostly 3 per bundle, 42—56 μ long.

In 1910, and later in 1917, KOWALEWSKI describes an *Amphichaeta* from Poland, living in fresh water, which he identifies with TAUBER's *A. leydigii*, and which differs from *A. sannio* in the following characters: The dorsal setae of III are 5 per bundle, all the bundles of IV and V have only 2 setae, the rest have 4 setae. Thus, the number in IV and V is markedly smaller, compared with *A. sannio*. The setae are longer, being 69—75 μ in II, 75—84 μ in III, only 55—63 μ in IV and V, and 57—72 μ in the following segments. There is no vascular loop in the prostomium. The nephridia have no connection with the ventral vessel. They are mostly paired, and open immediately in front of the ventral setal bundles. The anterior border of the brain is straight, not drawn out to a tip. — The spermathecae are very long and tubular. I have made out their length from Kowalewski's Fig. 3 (like the following measurements); they appear to be about 200 μ long. The atrial ampulla is an enormously long sac, about 200 μ long, with a narrow distal part, which passes into the very wide, indistinct duct. This is about 50 μ long, with an outer diameter of about 30 μ at the widest place. The vasa deferentia are narrow, and only 40 μ long, opening immediately above the male duct. The male funnels are situated quite as in *A. sannio,* and are 35 μ long, 15 μ in diameter.

It seems quite clear, that this is a different species from that of Kallstenius. Which of them is to be identified with Tauber's species, is not possible to make out from the diagnosis of the latter, the scanty facts fitting in as well, or as badly, with them both. As it was found in fresh water, it seems most probable to me, that it was identical with that of Kowalewski.

In 1926 Michaelsen unites *A. leydigii* and *A. sannio* under the name of *A. leydigi* Tauber. He gives the number of setae in specimens found by himself in the lower part of Elbe, some of which are in this respect something of a link between the two species. He argues, that the more "pure" forms are found only in small, inbreeding communities of no systematic value. As both my specimens from the gulf of Bothnia, and those of Knöllner (see below) from the gulf of Kiel show the same characters as those of Kallstenius, this does not seem probable. Michaelsen's own specimens undoubtedly belong to the Kowalewskian species, as most of them show a marked diminution of the setal number in IV and V, and a number of 4 is frequently found in the posterior segments. Michaelsen tries to explain the difference between *A. sannio* and *leydigii* by assuming that Kallstenius had only immature specimens in which the decrease of the number of setae "in the genital segments" had not yet been accomplished. This is excluded, as Kallstenius had many sexually mature specimens, whereas Michaelsen had only budding ones; besides, there is no reason to assume any correlation between the number of setae in IV and V, and the sexual phase. In respect of the nephridia, M. claims to have seen the *sannio* condition in one living specimen, but not in preserved ones, nor in sections. He argues, that the connection may be present in life, but is lost on killing. This is not, however, the case at all, the connection being far too close.

Wolf (1928) reports an *Amphichaeta leydigi* in the Moldau, showing exactly the same setal conditions as that of Kowalewski. The setae were about 64 μ long. Also, there was no connection between nephridia and ventral vessel. The body-size was smaller, 1—1.5 mm. This form without doubt belongs to *Amphichaeta leydigii,* as I have defined it.

So is the case with *Amphichaeta leydigi* from Switzerland, of Piguet (1928). He gives no detailed account of the setae, but he mentions that they are fewer in IV and V, nearly always 1—2, against 1—5, most often 3—4 in the rest. The length of the setae in his specimens was smaller than in the Polish specimens, 43—72 μ, those of III being longest. The length of the body was not more than 1 mm.

Knöllner (1935), on the other hand, reports *Amphichaeta leydigi* from the Baltic (Kiel Bay), which agrees with *A. sannio*. It has 3—4 setae in II and III, and 3 setae in the other segments, a number of 1—2 being very seldom met with. He mentions, that the nephridia had no connection with the ventral *nerve-cord*, and claims this as a support for Michaelsen's opinion, having obviously misread his paper.

In 1924 Lastočkin described specimens from the river Uvodi, Russia, which he attributes partly to *A. sannio*, partly to a new variety of *A. sannio*, var. *multisetosa*. The latter has the characters of Kowalewski's *A. leydigi*, the setae of the different segments being of exactly the same number as in the latter. They are somewhat shorter, like those of Piguet's specimens: in II 42—62 μ, in III 48—68 μ, in IV—V 40—57 μ, in the rest 40—64 μ. The nephridia are paired, and as a further difference from *A. sannio*, he remarks, that the bulbous dilatation of the oesophagus is situated in V in the variety, but in IV in the main form (in Kallstenius' specimens it is situated with a half in each). Most likely this var. *multisetosa* is identical with *A. leydigi* of Kowalewski, which was always found in fresh water. What L.'s *A. sannio* may be, I cannot judge. It is stated to be found living together with the "variety" in masses in foul water. It has a great likeness to *A. sannio* of Kallstenius, having 3—4 setae in all bundles (ventrally in III, however, 4, whereas *A. sannio* has 3). The lengths are even shorter than in the latter: in II 32—48 μ, in III 41—55 μ, in the rest 37—52 μ. The nephridia are stated to be mostly unpaired. Lastočkin tries to explain the presence of a species and its "variety" in the same locality as due to the asexual reproduction, which tends to keep different strains stable. Such a great difference as in the present case would, however, necessitate the cutting out altogether of sexual reproduction, and such an assumption seems too rash. Whether the specimens referred by L. to *A. sannio* really belong to this species, which was elsewhere found only in brackish water, or to a new species, is as yet impossible to tell. L. argues, that if *Amphichaeta* are found abundantly in the White Sea, the Arctic Ocean, or the southern seas (the Black Sea etc.) they may possibly be transported by migratory birds (they cannot be brought from the Baltic, as no birds migrate from there over Ivanovo-Voznesensk).

Michaelsen (1928, p. 75) states that *Amphichaeta* swims "unter peitschenden Körperbewegungen." Probably he has misinterpreted Kallstenius, who saw it make "eine Art häftig schlängelnder Bewegungen" in the free water, but without change of place, thus not actively swimming.

Subfamily *Paranaidinae* subfam. nov.

Type genus: *Paranais* Czerniavsky.

No eyes. Dorsal setae from V onwards, all double-pronged crotchets. Pharynx with dorsal diverticulum; pharyngeal and septal glands present; stomach present. No nephridia. Coelomocytes present. Testes and spermathecae in IV, ovaries and atria in V; no prostate gland cells. 4 segments formed at anterior end, by budding.

Genus: **Paranais** Czerniavsky, 1880.

Generic type: *Paranais litoralis* (Müller).

Ventral setae all of one shape. One pair of septal glands, in IV. Dorsal vessel mid-dorsal; commissural vessels in I—IV forming a plexus; in some following segments a free loop. Clitellum present between male pores; penial setae present.

It has appeared necessary to subdivide the old genus *Paranais*, which comprised all species with only double-pronged crotchets dorsally and ventrally (except *Amphichaeta*), however different they might be in other respects.

The species *P. litoralis* (Müller), *P. simplex* Hrabě, *P. frici* Hrabě, and the new species *P. botniensis* have dorsal setae beginning in V, one pair of septal glands in IV, no nephridia whatsoever, and behind the pharyngeal vascular plexus some additional loops are present, as well as (in a couple of the species, at least) paired segmental vessels in the newly-formed segments at the posterior end. Further, in all of these species, the sexual organs are situated one segment further forwards than usual, and only 4 segments are formed anteriorly on budding. There is no prostate, the vasa deferentia open into the atria at the beginning of the atrial ducts, which open on the clitellum. The spermathecal and atrial ducts are well-defined (particulars about the sexual organs in *P. frici* have not been given). These species have here been separated as the genus *Paranais*; this genus was erected by Czerniavsky (1880) for the species *litoralis* and *uncinata*, and *litoralis* as standing first is entitled to the generic name on separation.

To the same genus have been provisionally assigned the two species *P. macrochaeta* Černosvitov and *P. salina* Černosvitov, because their dorsal setae begin in V, and, at least in the former, 4 segments are formed at the anterior end on budding; in other respects they are too little known to allow of any certain classification.

The species *P. setosa* Moszynski apparently has very little in common with the above-mentioned species. It has dorsal setae beginning in II, apparently no septal glands, nephridia present as usual, and no additional vessels. The sexual organs have the usual position, so presumably 5 segments are formed anteriorly in budding-zones, though it is not stated.

There seems to be no prostate, as in *Paranais*, but the vasa deferentia open into the most proximal end of the atria, and these have no ducts, but open directly outwards into an invagination of the body-wall. Neither have the spermathecae any ducts. I have provisionally assigned also *P. naidina* (Bretscher), and *P. lacteus* Černosvitov to the same genus as *P. setosa*, on account of their dorsal setae beginning in II, though otherwise too little is known of them. *P. naidina* has already once been given a special generic name, *Homochaeta* Bretscher, which has been readopted here for convenience, though it is possible that when the sexual organs of *H. naidina* are known, it will become necessary to separate the species into different genera, and the generic diagnosis then will have to be altered in accordance.

The species *P. uncinata* (Ørsted) has eyes, in contrast to all the other species, the dorsal setae begin in VI, nephridia are present, but no septal glands and no additional vascular loops. The sexual organs are situated in the usual segments, and 5 segments are budded anteriorly, as in *Homochaeta*. The vasa deferentia, however, are provided with prostate glands, and open into the distal end of the atria, which have distinct ducts, opening on a clitellum-free space of the body-wall; the spermathecae have well-defined ducts. The genus *Uncinais* was erected for this species (and *Paranais litoralis*) by LEVINSEN (1884); this will thus be the appropriate name for the species *uncinata* on separation.

For species not mentioned above, which have hitherto been referred to *Paranais*, see pp. 91, 93 and 94.

Paranais litoralis (Müller, 1784).

Figs. 8 *A–D*; Pl. III, fig. 1.

Nais litoralis MÜLLER, 1784, pp. 120—123, Pl. LXXX, figs. 2—6.

Nais littoralis Müller. GMELIN, 1788—1793, p. 3122 [*partim*]. LAMARCK, 1816, p. 223 [*partim*]. TABL. ENC. MÉTH., 1827, p. 134, Pl. LIV, figs. 4—10 [*partim*]. BLAINVILLE, 1825, pp. 129—130 [*partim*]; 1828, p. 498 [*partim*]. GRUBE, 1851, p. 104.

Blanonais littoralis (Müller). GERVAIS, 1838, p. 15 [*partim*].

Nais littoralis Ørsted (Müller ex parte). ØRSTED, 1842, p. 136.

Enchytraeus triventralopectinatus MINOR, 1863, p. 36.

Paranais littoralis (Ørsted). CZERNIAVSKY, 1880, p. 311. DE VOS, 1922, p. 276.

Uncinais littoralis Ørsted. LEVINSEN, 1884, p. 218.

Paranais littoralis O. F. Müller. BOURNE, 1891, pp. 348—352, Pl. XXVI, fig. 2, Pl. XXVII, figs. 3—6. MOORE, 1905 b, p. 376.

Uncinais littoralis (O. F. Müller). BEDDARD, 1895, pp. 295—296.

Paranais litoralis (Müller, Ørsted). MICHAELSEN, 1900, p. 18; 1909 a, p. 12, Fig. 16; 1927 a, pp. 8—9, Fig. 3. WOLF, 1928, p. 388. UDE, 1929, pp. 25—26, Fig. 20. KONDÔ, 1936, p. 384, Pl. XXIII, fig. 7.

Paranais litoralis (Müller). SMITH, 1918, p. 639. KNÖLLNER, 1935, pp. 429—433, Figs. 1—4. HRABĚ, 1936, p. 1279. ČERNOSVITOV, 1937 a, pp. 71—72, Fig. 1.

Ventral setae with nodulus distal; those of II 5—7 per bundle, slightly longer than the rest, with distal tooth longer than proximal; in the remaining segments usually 2—3 per bundle, distal tooth posteriorly equally long as, or slightly longer than proximal; dorsal setae slightly thinner than ventral. Stomachal epithelium with intra-cellular canals. Simple commissural loops in V—VI, or V—VII. Spermathecal ampulla long, cylindrical, duct short; atrial ampulla large, cylindrical, extremely muscular, duct short, narrow; vasa deferentia extremely narrow, joining atria immediately above atrial duct; penial setae very stout, with a simple hook. $n = 14$—17. $s = 13$—46. $l = 9$—14 mm (living, mature), 2—3.5 mm (preserved).

Europe (The Thames outlet, the Zuiderzee, Kiel Bay, Öresund, Istria?), N. America.

Sweden: Scania: Sjölunda (ALMSTEDT, 1946) (?); Hårsfjärden, Gällnarfjärden, Klintsundet, Vettersö (S. BOCK coll.). In salt or brackish water.

The first one to give a more or less full description of *Paranais litoralis* was BOURNE (1891). According to his description the setae all have a longer distal tooth (op. cit., Pl. XXVII, figs. 4, 6), and are 5 per bundle ventrally in II, 3 per bundle in all other segments, ventrally and dorsally. The dorsal setae are somewhat longer and thinner than the ventral ones, and the ventral setae of II are longer and thinner than those following. The stomach begins in VIII. There are anastomosing commissural vessels in I—IV, and short, simple loops in V—VII (op. cit., Pl. XXVI, fig. 2). The atria, in V, are long, almost tubular, directed forwards (op. cit., Pl. XXVII, fig. 3), the penial setae are very stout, but have the usual shape, with a simple, distal hook (op. cit., Pl. XXVII, fig. 5). — Probably identical with this form are the specimens reported by DE VOS from the Zuiderzee, which had 3 setae per bundle with longer distal tooth, the dorsal ones being longer and thinner than the ventral.

KNÖLLNER (1935), who gives a detailed description of the sexual organs, seems to have had a slightly different form before him. The setal numbers usually agree with BOURNE'S description, but there may be as many as 5—7 in II, and 3—5 in the other segments. K. does not make any statements about their shape, but his Fig. 4 b shows a dorsal seta with teeth about equally long. The length of mature individuals was up to 14 mm. — The shape of the sexual organs seems, however, to agree, as far as can be judged. The atria are long, straight, cucumber-shaped, and the penial setae agree with BOURNE's figure, though they are not quite so stout. The spermathecae are not shown in BOURNE's figure; in KNÖLLNER's they are very long, shaped very much like the atria, with a short duct, not marked off externally. The atrial ampullae have an extraordinarily strong muscular layer, and the ejaculatory duct is narrow, the vas deferens opening immediately above it. The clitellum is not absent round the male pores.

ČERNOSVITOV (1937 a) gives a diagrammatic side-view of the sexual organs of a specimen from Bulgaria. The spermathecae here are more baglike, but the atria "schlauchförmig."

I have had the opportunity to examine specimens collected by the late Prof. S. Bock from the Baltic off Stockholm, which I refer provisionally to Knöllner's form, as all characters that can be checked agree very well. The following table gives approximate extreme and mean values in μ of setae from 8 specimens:

	v.s. II	v.s. V	v.s. post.	d.s
number	5–6	2–3	2–3	2–3
extr. length	60–80	60–75	58–80	58–77
mean length	75		65	65
thickn.	2–2.2	2–2.7	2–2.7	1.8–2.2
teeth	$\frac{4.5\text{–}6.5}{3\text{–}4.2}$	$\frac{3\text{–}4.8}{3\text{–}4.5}$	$\frac{3\text{–}4.2}{3\text{–}3.5}$	$\frac{3\text{–}3.7}{3\text{–}3.5}$

As shown by the table (and Fig. 8 *A—D*, p. 89), the dorsal setae are somewhat thinner, but not longer, than the ventral, and in the ventral setae of II the distal tooth is much longer than the proximal one, the difference growing smaller towards the rear, at last disappearing. — The nodulus is distal in all the setae. In Knöllner's specimens the setae in II were about 75 μ long, the rest about 62 μ.

Free commissural vessels are present only in V—VI, but their appearance is similar to that shown in Bourne's figure, short and unwinding. The vascular plexus round the pharynx is fairly sparse. The pharyngeal and septal glands have a similar appearance as in *P. botniensis* (cf. p. 88), though the septal glands are not interwoven with blood vessels to the same degree, due to the scarcity of the latter. — The stomach usually lies in VII, and its epithelium contains intra-cellular canals (Pl. III, fig. 1; cf. p. 23), ciliated like the whole surface of the epithelium; there is no brush border. — Hrabě (1936) mentions specimens of *Paranais litoralis* from Istria with *inter*-cellular canals in the stomachal epithelium — presumably he was mistaken and the canals were intra-cellular in this case, too, and the forms identical. — The chloragogen is scanty compared with that of *P. botniensis*. and the intestine is not especially wide. — $n = 14$—16, $s = 13$—16. The body-length of the preserved animals was 1.8—3.5 mm. Thus, the animals were much smaller than those reported by Knöllner ($s = 46$, $l =$ up to 14 mm), though the setal characters seem to agree. Sexual organs were not present, so they cannot be compared with those of Knöllner's and Bourne's specimens, and the conditions of the stomachal epithelium in the latter forms are not described, so it cannot be judged with any certainty, if the forms are really identical, though I have provisionally assumed this to be the case. Very possibly Bourne's, Knöllner's, and my form may each represent a geographical race, or even distinct species. Which of the forms Müller's original specimens belonged to is uncertain, but Knöllner's form is geographically nearest to it. In fact, it may have belonged to *P. friči*, but it is most convenient to assume it to represent the same species as Bourne's specimens.

Paranais friči Hrabě, 1941.

Fig. 8 *E–H*.

Paranais friči Hrabě, 1941, pp. 20—22, Figs. 16—19.

Ventral setae of II 2—4 per bundle, with nodulus median, and distal tooth more than twice as long as proximal; in all other segments dorsally and ventrally 1—2 setae per bundle, or dorsally in V 3 per bundle, with nodulus distal, and distal tooth longer than proximal. Stomach in VII, without intra-cellular canals. Simple, non-winding commissural vessels in V—VI. Penial setae shaped like ordinary ventral setae. $n = 9—13$. $s = 32$. $l = 2.7—5.7$ mm (preserved), 9 mm (living).

Czechoslovakia (the Danube).

Sweden: Gällnarfjärden, Klintsundet, Vettersö-Växlet (in brackish water; S. Bock coll.).

I have identified a form, collected by the late Prof. S. Bock, with Hrabě's form, although the latter was found in fresh water, as the setal characters agree very well. The form of the setae is very different from that of the fore-going species — they are much slenderer compared with their length, and the teeth are less curved, the distal one being up to almost twice as long as the proximal, including the posterior segments (Fig. 8 *E—H*). In my specimens the setae were still more scanty than in Hrabě's, being often only 1 per bundle, except in II. Hrabě states the length to be 95—104 μ in II, 81—90 μ in III, 95 μ in IV—V, and 86 μ in VIII. The following table shows the measurements in 3 specimens of the Swedish form:

	v.s. II	v.s. V	v.s. post.	d.s.
number	2–4	1–2	1–2	1–2
length	80–105	80–85	73–90	73–85
thickn.	2–2.2	2–2.2	2–2.2	1.8–2
teeth	$\frac{6.2-7}{2.5-2.6}$	$\frac{6.2}{3}$	$\frac{6.2-6.8}{3.3-5.1}$	$\frac{6.2-6.8}{3.3-5.1}$

As can be seen, the measurements agree well with those of *P. friči*, and are considerably larger than in *P. litoralis*, and *P. botniensis*.

Hrabě does not mention anything about the internal anatomy, but in the Swedish specimens the stomach does not contain any intra-cellular canals. Otherwise the characters agree with those of the Swedish specimens of *P. litoralis*, the free commissural vessels being short and unwinding, the pharyngeal net-work fairly scanty, only faintly merging with the septal glands, the chloragogen not very thick, and the intestine not abnormally wide. — Hrabě found sexually mature specimens, but only mentions that the spermathecae open on IV, in front of the ventral setae, the atria being in V. The ventral setae of V in mature animals are stated to be 2—3 per bundle, more deeply sunk than ordinary setae — these setae apparently correspond to the penial setae in the other species (cf. p. 52). — *n* in the Swedish specimens was 9—13, in the Czechoslovakian 13, *s* in the latter was = 32. — The low number of setae distinguishes this species from all related forms, and the shape of the setae from all except *P. macrochaeta*, which has a large number of very strong setae.

Paranais simplex Hrabě, 1936.

Paranais litoralis (O. F. Müller). Lastočkin, 1922, p. 279.
Paranais simplex Hrabě, 1936, pp. 1268—1270.
Paranais simplex Hrabě. Hrabě, 1941, p. 22.

Ventral setae of II 5—6 per bundle, not longer than in neighbouring segments, with equally long teeth, in the remaining segments and dorsally 3—4 per bundle, with distal tooth shorter than proximal; setae in anterior segments longer than the rest. No canals in the stomachal epithelium, no distinct stomachal dilatation. Simple commissural vessels in V—VII. Spermathecal ampulla large, ovoid, duct short, narrow; vasa deferentia short, straight, joining atria above atrial duct; atria ovoid or cylindrical, atrial duct short, narrow; penial setae shaped like ordinary setae, but fewer. $n = 17—24$. $s = 28—41$. l (mature) = 4—4.5 mm.

Russia. Found in fresh water.

The ventral setae are stated by Lastočkin (1922) to be 76—92 μ long, the dorsal 76—87 μ. — The species agrees with *P. friči* in having no intra-cellular canals in the stomach, but the setae are numerous, and shaped quite differently, with the proximal tooth longer in all segments except II. — The sexual organs are not very thoroughly described, but seem to agree fairly well with those described by Knöllner in *P. litoralis*, only H. states that there are no penial setae; the ordinary ventral setae are fewer in the atrial segment, and "are stuck deeply in the hypodermis, and their distal ends touch each other" — this is, however, very typical for penial setae, and it seems most probable that they are in reality penial setae, and represent, together with those of *P. friči*, the first link in a series of forms to *P. litoralis* through *P. botniensis* (cf. p. 90).

Paranais botniensis sp.nov.

Holotype at the Museum of Natural History, Stockholm.
Fig. 8 *I–M*; Pl. III, figs. 2–7.

Diagnosis: Ventral setae all with nodulus distal, those of II 5—6 per bundle, longer than the rest, with distal tooth about twice as long as proximal, in the rest 2—4 per bundle, in III—IV difference between teeth diminishing, in posterior segments teeth about equally long; dorsal setae with distal nodulus, 2—4 per bundle, slightly thinner than ventral, with teeth equally long. Stomachal dilatation in VIII, or VII, without intra-cellular canals; intestine extremely wide; chloragogen excessively dense and thick. Commissural vessels in V—VI, or V—VII, simple but winding; pharyngeal plexus very dense and complicated. Clitellum in 1/2 IV—VI; spermathecal ampulla small, globular, duct relatively long and strong; male funnels large, vasa deferentia very narrow and thin-walled, entering atria immediately above atrial duct; atrial ampulla oblong, muscular layer not extremely thick, duct long, well-defined; penial setae 2 per bundle, long, straight, double-pronged, with nodulus strongly distal. $n = 14$. $s = 22$. $l = 6$—10 mm.

Sweden: Kräkångersfjärden, Stora Gladaviken. In faintly brackish water, in the surface layer of a very loose, muddy bottom, in very shallow water at the shore. 12 specimens.

The setae of this form are somewhat shorter still than in *P. litoralis.* The following table gives measurements from 4 specimens:

	v.s. II	v.s. post.	d.s.
length	51–75	48–67	45–65
thickn	1.8-2.2	1.8–2.2	1.6–2
teeth	$\frac{6}{3}$	$\frac{3.7\text{–}4.5}{3.5}$	$\frac{3.5\text{–}4.2}{3.2\text{–}4.2}$

All setae have a distal nodulus, as in *P. litoralis*, and the ventral setae of II (Fig. 8 *I*) have the distal tooth about twice as long as the proximal. This difference is smaller in III and IV, and has almost disappeared in the posterior segments (Fig. 8 *K*, *L*). The dorsal setae usually have equally long teeth, though the distal is sometimes longer (Fig. 8 *M*). Thus, the setae are very similar to those of *P. litoralis.* — The setae of II are situated more laterally than the rest, as in *P. macrochaeta.*

The three first segments are much shorter than the rest, as in *P. macrochaeta* (p. 91). — The pharynx, with its dorsal diverticulum, occupies only III. — The pharyngeal gland cells are dense on the diverticulum. The septal glands, in IV, are two masses, one on either side of the gut, and in close connection with septum 3/4. They reach through the whole segment, and may be so large that in mature specimens they completely hide the spermathecae. They are closely interwoven with the vessels of the pharyngeal plexus. — The stomach is well marked, and is situated in VII, or more frequently in VIII. Its epithelium does not contain any intra-cellular canals; it is invested with a brush border (Pl. III, fig. 2). — The foremost part of the intestine is fairly narrow, but then it becomes enormously wide. When filled with e. g. small stones, as is usually the case, it fills up, together with the chloragogen, the whole body cavity, where the free space in the other forms is fairly large, due to the absence of nephridia. The chloragogen, present from V, is often extremely strong on the intestine, so that the worm appears dark-brown in colour.

The vascular system is extremely richly developed. The commissural vessels in II—IV form a dense plexus (I have called it the pharyngeal plexus, although it is present also in IV). In II and III the plexus lies free in the coelom, but in IV it merges with the septal glands. In V, VI, and VII, or in V and VI, if the stomach lies in VII, there are free vessels, very long and winding, each forming a loop forwards, which may even reach into the preceding segment. There may also be a pair of vessels in the stomachal segment, but they are intimately connected with the gut, and seem to belong to the intestinal plexus. — On maturity the vascular system attains quite an excessive degree of development, so that the vessels fill vast parts of the body, especially round the sexual organs, and in the sperm-sac and egg-sac (Pl. III, fig. 4). — In newly-formed segments there is one pair of transverse vessels per segment (cf. p. 40).

As in the other forms there are no nephridia whatsoever.

The clitellum, reaching from $^1/_2$ IV through V and VI, is not absent in the vicinity of the male pores. The largest body diameter in this region is about 170 μ. — The testes and ovaries have disappeared in my specimens.

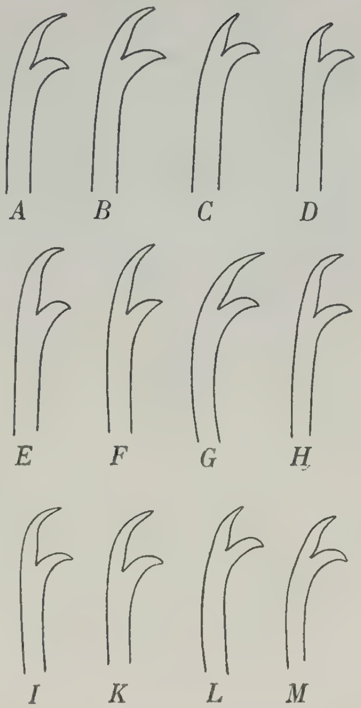

Fig. 8. *A-D Paranais litoralis, E-H P. friči, I-M P. botniensis.* Distal ends of setae. *A, E, I* ventral setae from II, *B, F, K* from III, *C, G, L* from a posterior segment, *D, H, M* dorsal setae. 1500 ×.

The spermathecae are much smaller than those described by KNÖLLNER in *P. litoralis.* The ampulla, approximately globular (Pl. III, fig. 3 and Fig. 27 *D*), is 40—50 μ in diameter, 50—60 μ long, when filled with sperm. The wall is then 2—3 μ thick. The duct is very sharply set off (Pl. III, fig. 3), about 33 μ long in one specimen measured, and 13—20 μ in diameter, with walls of a high epithelium of cylindrical cells. Thus, the walls are not thin, as in the other species, and only the most distal part is narrow.

The male funnels are large, about 30 μ long and 15 μ in diameter, with the wall 3—7.5 μ thick (Pl. III, fig. 5). — The vasa deferentia (Pl. III, fig. 4) are extremely thin, 4.5—6 μ in diameter, with walls 1.5—2 μ thick. Behind the first downward curve they go straight to the atria, and open above the atrial duct. They are about 90 μ long. — The atria are fairly large, the ampulla oval, 65—75 μ long, at a diameter of 36—54 μ. Its wall-thickness is only 6—9 μ, most of which is formed by the inner epithelium, so that the muscular layer is only 3—4 μ thick, against 18 μ in *P. litoralis* (Pl. III, fig. 6). — The ejaculatory duct is well-defined, 35—45 μ long, but only 10—12 μ wide, with a strong muscle layer, and thin, not cylindrical epithelium (Pl. III, fig. 6). It opens on the clitellum.

The penial setae do not resemble those described by Bourne and Knöllner in *P. litoralis*. They are longer than the ordinary setae, 78—84 μ, but not thicker, and much straighter, with the nodulus strongly distal (Pl. III, fig. 7) about 1/4—1/5 from the tip. They have two about equally long teeth, at a wide angle.

The sperm-sac stretches through X, the egg-sac through XI.

If the measurements are compared with those given by Knöllner (1935) for *P. litoralis*, it appears that each of the genital organs is about half as large in the present form, except the penial setae which are even longer (75 μ acc. to K.). Also, the size of the animals is about half as great, e. g. the diameter in the clitellum region which is 325 μ in *P. litoralis*, but the setae only slightly shorter.

If I am wrong in identifying the specimens from the coast of Uppland (p. 85) with *P. litoralis*, and if the latter is found to have no intracellular canals in its stomachal epithelium (which character seems to me to be certainly a specific character), it may be that the present form represents only a geographical race of *P. litoralis*, but as yet it seems most reasonable to assume it to be a separate species. — The main differences from *P. litoralis* are then: 1) The absence of intracellular canals in the stomachal epithelium; 2) The enormous width of the intestine; 3) The different shape of the spermathecal ampulla and duct; 4) The thin muscular layer of the atria, and the long atrial duct; 5) The different shape of the penial setae. — Other differences are the much smaller size of body and sexual organs, and the different development of the vascular plexus and commissural vessels. — The characters separating it from *P. simplex* are: 1) The length of the setae, and the relation of length of the setal prongs; 2) Presence of a distinct stomachal dilatation, and the width of the intestine; 3) Different shape of spermathecal ampulla and duct, and atrial duct; 4) Different shape of the penial setae. — The differences against *P. friči* are, as far as known: 1) The larger number, much smaller length, and quite different shape of the setae; 2) The width of the intestine; 3) The different shape of the pharyngeal plexus and simple commissural vessels; 4) The different shape of the penial setae.

Paranais macrochaeta Černosvitov, 1939.

Paranais macrochaeta Černosvitov, 1939, pp. 86—87, Figs. 15—19.

Segments I—III narrower than the rest, covered with cutaneous glands, and with coelom traversed by numerous peritoneal strands. Dorsal setae 4—6 per bundle; ventral setae in II 8—9 per bundle, longer, straighter and thicker than the rest, displaced laterally; in III—IV 1—3 per bundle, in the remainder 4—5 per bundle; all setae with distal tooth much longer than proximal. Stomach in VI (?). $n = 11$. l (preserved) = 2—2.15 mm.

S. America (Titicaca basin). In fresh water. (2 specimens).

The setae of II are stated to be about 120 μ long, 2.6 μ thick, the other setae 75 μ long, 1.7 μ thick.

The oesophagus is stated to open into the intestine in VI; this widening probably represents the stomach. Nothing is mentioned about septal glands, vascular system, or nephridia.

The peculiar shape of the anterior end, and the unusually high number of elongated and thickened setae in II separate this species from the other forms.

Paranais salina Černosvitov, 1939.

Paranais salina Černosvitov, 1939, pp. 84—86, Figs. 8—14.

Dorsal setae 2—3 per bundle, with teeth equally long; ventral setae of II displaced laterally, 5 per bundle, with distal prong twice as long as proximal, in III 3—4 per bundle, with distal tooth 1 1/2 as long as proximal, in the remainder 2—3 per bundle, with teeth equally long. Stomach in VIII (?); anus opening into a fossa with a rectangular incision in the dorsal wall. Septal glands present (?). $s = 30$—40. l (preserved) = 3—4 mm. Budding not observed (12 specimens).

S. America (Titicaca basin). In oligohaline water.

All setae are stated to be 70—80 μ long. The passing of the oesophagus into the intestine probably marks the beginning of the stomach. Groups of chromophil cells are mentioned for IV; probably they represent septal glands. — The vascular system and nephridia were not visible.

It is not possible to judge whether the present species really belongs here, as the known facts are too scanty.

If *Paranais palustris* Udalicov, 1907, is yet another species or is identical with one of the above species of *Paranais*, or perhaps does not even belong to this genus, cannot be judged, as Udalicov's paper has not been accessible. It has also been recorded by Behning (1924), and seems to be found both in fresh and saline water, but no description whatever is given.

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The facts known about most of the species of *Paranais* are too scanty to allow of any strongly founded conclusion as to the relationships of the species. — The presence of intra-cellular canals in the stomach does not seem to have here such a great taxonomical value as in *Pristina*, where the special sort found in the genus seems to occur in all species, and in no other genus.

Subfamily *Naidinae* Lastočkin, 1924.

Type genus: *Nais* Müller.

Eyes often present. Pharynx with dorsal diverticulum; pharyngeal and oesophageal or septal glands present. Commissural vessels in I—V more or less simple or forming a plexus, additional free loops often present, sometimes in all segments. Testes and spermathecae in V (seldom IV), ovaries and atria in VI (seldom V). 5 (seldom 4) segments formed anteriorly, by budding or fragmentation.

Genus **Homochaeta** Bretscher, 1896.

Generic type: *Homochaeta naidina* Bretscher.

No eyes. Dorsal setae from II, all double-pronged crotchets of similar shape as the ventral setae. Stomachal dilatation probably present. Vascular commissures in anterior segments simple, or forming a net-work. Spermathecae and atria without ducts; no prostate gland cells; penial setae present.

Homochaeta naidina Bretscher, 1896.

Homochaeta naidina Bretscher, 1896, pp. 508—509.
Naidium naidina (Bretscher). Bretscher, 1899, p. 393.
Paranais naidina (Bretscher). Michaelsen, 1900, p. 18; 1909 a, p. 12. Piguet & Bretscher, 1913, p. 16. Ude, 1929, pp. 26—27. Kondô, 1936, p. 384, Pl. XXIII, fig. 6.
[?] *Osaka shimasakii* Kondô, 1936, pp. 383—384, Pl. XXIII, fig. 5.
[?] *Paranais heteroseta* Kondô, 1936, p. 384, Pl. XXIII, fig. 8.
[?] *Paranais shimasakii* (Kondô). Černosvitov, 1939, pp. 87—88.
[?] *Paranais japonica* Černosvitov, 1939, p. 88.

Prostomium elongated, pointed. Anterior segments pigmented. Dorsal setae of II—V 5—6 per bundle, longer and slenderer than the rest, with longer distal prong; in the other dorsal segments, and in all ventral segments setae 3—5 per bundle, with prongs equally long. Stomach in VIII (?). Transverse vessels in I—V forming a capillary net-work. $s = 20$. $l = 8$ mm.

Europe (Switzerland), Japan.

Bretscher (1896) states that eyes may be present or absent, but in 1899 he places the species in *Naidium*, quoting the diagnosis of O. Schmidt, with the passage: "Augen sind nicht vorhanden," so presumably he was mistaken in his first statement. Later authors do not mention eyes. The intestine is stated to be enlarged in VIII; this probably represents the beginning of the stomach.

The two species *Paranais heteroseta* Kondô (= *Paranais japonica* Černosvitov), and *Osaka shimasakii* Kondô (= *Paranais shimasakii* (Kondô), Černosvitov, 1939) probably belong here. The only difference between the two species seems to be the presence of simple-pointed setae dorsally in the posterior half of the body in the former species, and in all segments dorsally and ventrally in the latter. Thus, the former constitutes a transitional stage between the latter and *H. naidina*. All three were also found together in the water-works of Osaka. A difference in all three forms found by KONDÔ from *H. naidina* as originally described is the short, obtuse prostomium. Possibly none of them in reality belong to *H. naidina*, but this is quite impossible to judge from the inadequate descriptions.

Homochaeta setosa (Moszynski, 1933).

Fig. 27 *C*.

[?] *Paranais multispinus* MICHAELSEN, 1914, pp. 150—151, Pl. IV, fig. 4.
Paranais setosa MOSZYNSKI, 1933, pp. 141—143, Fig.

Prostomium short, obtuse. No pigment. All setae of the same shape, with proximal prong longer than distal; in II and III 4—8 setae per bundle, in the other segments up to 12. Stomach in VIII (?). Clitellum in V—1/2 VIII; spermathecal ampulla pear-shaped, thin-walled, opening directly outwards; vasa deferentia short, straight, narrow; atria elongated, proximal part narrow, curved forwards, distal part wide, muscular, opening directly outwards into an invagination; penial setae 5 per bundle, wholly resembling ordinary setae. $s =$ up to 50. $l =$ up to 10 mm.
Europe (Poland), Africa?

The intestine is stated to be dilated in VIII, probably the stomach. It is not expressly stated that the atria and vasa deferentia lack gland cells, but none are figured (fig. 27 *C*).

Possibly *Paranais multispinus* Michaelsen, from S. W. Africa belongs here. It has the large number of setae — up to 11 per bundle, less in II—III, and VII, with the proximal prong longer than the distal. The smaller body-size — length 3 mm — is quite natural, as it was measured from the first zooid of a preserved specimen, and MOSZYNSKI's specimens were mature. It is, however, stated to have some darker cells scattered in the body-wall, and a dilatation of the gut in VI, so the identification is not quite certain.

Homochaeta lactea (Černosvitov, 1937).

Paranais lacteus ČERNOSVITOV, 1937 b, pp. 141—143, Figs. 17—20.

Prostomium short, rounded. Setae all with prongs equally long, in the anterior segments 6—8 per bundle, in the rest 4—5; in II—VI longer than the rest. Pharynx in II—III, stomach in VII (?). Dorsal vessel mid-dorsal, simple vascular loops in III—VI. Chloragogen from VII. First nephridia in IX. Coelomocytes present. $s = 30$. $l = 5$ mm. No budding observed. Swims with lateral movements.
S. America (Argentine).

The setae of II—VI are stated to be 36—39 μ long, the rest about 32 μ. The anus opens into a fossa with a broad rectangular incision in the dorsal wall, as in *Paranais salina* Černosvitov (p. 91). The oesophagus is stated to open into the dilated intestine in VII. This probably represents the beginning of the stomach. — The statements that the setae of II—VI are longer than the rest, that the chloragogen begins in VII, and that transverse vessels are present in VI in addition to the anterior segments, suggest the possibility of the budding of 6 segments instead of 5. The species needs investigation (cf. below).

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About the re-erection of the genus *Homochaeta* see p. 82.

As to *Homochaeta lactea* (Černosvitov), its place is wholly uncertain. It was described from one, non-budding specimen. I have provisionally placed it in *Homochaeta* on account of its dorsal setae beginning in II, but it may not even be a Naid. The situation of the first nephridia, in IX, and the statement that the post-septal part is large, are suspect.

Paranais tenuis Černosvitov (1937 b), with dorsal setae from II onwards, was shown by MARCUS (1944, p. 80) to be identical with the Tubificid, *Aulodrilus limnobius* Bretscher.

Paranais elongata Pierantoni (1909) seems also certainly to be a Tubificid. It was not found budding, though watched in numbers for a long time. The vascular system was typically Tubificid, with an unpaired longitudinal branch from the dorsal vessel in V—VII, and strong "hearts" in IX and X. The brain was shaped like a horse-shoe, quite as in "*Paranais tenuis*." Testes were reported in IX, ovaries in X.

Paranais (?) chilensis sp. inquir. Michaelsen (1926 d) = *Paranais (?) filiformis* (Schm?) (Bedd.) *sp. inquir.*, MICHAELSEN (1926 b) *partim*, is also probably a Tubificid, as it was not found budding. MICHAELSEN himself (1926 b) remarks: "Es erscheint mir durchaus nicht ausgeschlossen, dass wir hier einen sehr jugendlichen Tubificiden vor uns haben, etwa aus der Gattung *Limnodrilus*." — What *Chaetogaster filiformis* Schmarda = *Schmardaella filiformis* (Schmarda), MICHAELSEN (1925) = *Paranais (?) filiformis* (Schm?) (Bedd.) *sp. inquir.*, MICHAELSEN (1926 b) *partim*, which was reported to lack dorsal setae, may be, is impossible to judge, but probably it was no Naid.

Genus **Specaria** Sperber, 1939.

Generic type: *Specaria josinae* (Vejdovsky).

No eyes. Dorsal setae from VI, hairs and bifid needles; ventral setae all of one type. A stomachal dilatation present; pharyngeal and oesophageal glands present. Vascular system in I—V forming a net-work. Coelomocytes present. Clitellum absent round male pores; spermathecae opening laterally; vasa deferentia with prostate gland cells, joining atria immediately above atrial duct; atria without prostate cells, opening into eversible pockets; penial setae present.

Some doubts have been expressed in the literature (Stolte, 1933—1940, p. 555; Marcus, 1944, p. 53) as to the justification of the separation of *Specaria* and *Piguetiella* from *Nais*. So long as the genus *Nais* is used as a dust chamber, where all sorts of odd things are stowed away, it may seem superfluous to create new names for these two. But if the generic names are to have any taxonomic significance, it is obvious that the very homogenous group of the real *Nais* ought not to be lumped together with others, which cannot be said to be more related to them than are most other genera.

In the present genus the habit, and the absence of eyes (in itself no very strong indication) together with the vascular plexus, the peculiar situation of the nephridia, the mid-lateral openings of the spermathecae, the low epithelium of the atrial duct, and the existence of penial pockets are strongly distinctive features which place the genus farther apart from *Nais* than *Ophidonais* and *Uncinais*, the generic independency of which is questioned by nobody.

Specaria josinae (Vejdovsky, 1883).

Figs. 9, 26 *D*; Pl. IV, Pl. V, fig. 1.

Nais Josinae Vejdovsky, 1883, p. 218.

Nais Josinae Vejdovsky. Vejdovsky, 1884, p. 29, Pl. II, figs. 25—28, Pl. III, figs. 1—4. Vaillant, 1890, p. 373. Piguet, 1906, pp. 229—231. Piguet & Bretscher, 1913, pp. 30—31.

Nais josinae Vejdovsky. Beddard, 1895, p. 288. Michaelsen, 1900, p. 26; 1909 a, pp. 16—17. Fuchs, 1907, pp. 452—453. Schuster, 1915, pp. 40, 70, Fig. 25. Stephenson, 1925 b, p. 1310. Ude, 1929, pp. 44—45.

Specaria josinae (Vejdovsky). Sperber, 1939, pp. 3—5, Fig. 2. Hrabě, 1941, p. 4, Figs. 13—15.

No pigment. Dorsal setal bundles consisting of 2—6 hairs and 2—6 needles, curved, bifid, with nodulus distal and teeth about equally long; ventral setae all of one type, with a faint nodulus, slightly distal, or almost median, and distal tooth longer than proximal. Pharynx in II—III, oesophagus in IV—VI, stomach in VII—VIII. A pair of branching transverse vessels in VI; dorsal vessel ventrally to the left. Nephridial tubes packed closely round ventral vessel. Clitellum in V—1/2 VIII; spermathecal ampulla small, roundish, duct distinct; vasa deferentia with thick prostate, opening laterally into lower part of atria; atria thin-walled, small; atrial duct short; penial setae 1—3 per bundle, medially from pockets, with a simple hook distally. $n = 11—27$. $s = 14—53$. $l = 3—10$ mm. No swimming.

Europe, Bear Island.

Sweden: Waters in Småland, Närke, Lapland (Almstedt, 1946); Häggsjön (S. Berg coll.); Siljan, Storån, Lilla Gladaviken, Kyrksjön.

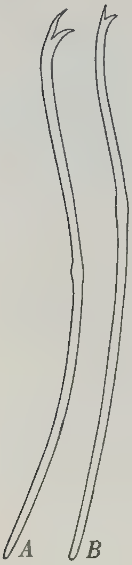

Fig. 9. *Specaria josinae*. *A* ventral seta, *B* needle seta. 900 ×.

Hair lengths measured by me: 135—180 μ, needles 72—85 μ, ventral setae 69—88 μ, 5—10 per bundle, similar in all segments. There is a distinct difference in type between the ventral setae and the dorsal needles (Fig. 9 *A*, *B*), though not so marked as in *Nais*, for example. I do not agree with Schuster, who considered them to resemble the ventral crotchets. In his Fig. 25 the curve of the teeth is much exaggerated.

There has been much confusion as to the vascular system. Vejdovsky (1884, Pl. III, fig. 2) describes and figures the vessels of I—VI quite correctly: an extremely complicated net-work of anastomosing vessels in the first 5 segments (the vessels are present in the whole space between the alimentary canal and the body-wall, and along the latter), and, in VI, one pair of free loops, branching once ventrally. He gives, however, a description of the rest of the vascular system that is not in accordance with my findings. He writes: "In den hinteren Segmenten ist das Rücken- und Bauchgefäss durch ein Paar langer Gefässschlingen verbunden, die unweit vor dem Dissepimente aus dem Rückengefässe entspringen (Taf. III, Fig. 3. *sv*), sich zuerst zu beiden Seiten und dann auf der Bauchseite nach vorne begeben, um sich mit dem Bauchgefässe, in der Mitte des Segmentes zu verbinden. — In dem 7., 8. und 9. Körpersegmente entspringen die Seitengefässe aus dem Herzen in der Mitte des Segments und verbinden sich direkt mit dem Bauchgefässe." By Beddard (1895) this has been transformed into: "The dorsal vessel anteriorly becomes reduced in calibre; it gives off, in the first five segments, five or six pairs of lateral branches, which form an irregular net-work; in the posterior segments pairs of lateral trunks (one pair to each segment) with the dorsal and ventral trunks. In segments vii, viii, and ix, these vessels are shorter and stouter, and form veritable hearts, comparable to those of the higher Oligochaeta." Piguet (1906) says nothing about the vascular system; and in Piguet & Bretscher (1913) nothing is mentioned about vascular trunks, nor does anybody else, who has investigated the species, mention anything about having seen them. They have, however, lived in the hand-books up to these days. Stephenson (1930, p. 148) writes: "In *Nais josinae*, however, and in *Haemonais*, the primitive condition persists; in these worms there is a complete series of dorso-ventral commissures —". Stolte (1933—1940, p. 408) quotes Fuchs (1907, p. 452), who states after Vejdovsky: "Da sind die Verhältnisse ähnlich wie bei den Tubificiden. In allen Körpersegmenten finden sich je ein Paar Dorso-ventrocommissuralia." I have, however, never found any trace of these transverse vessels, though I have sought for them in a large number of specimens. Thus I am positive that VEJDOVSKY must have been mistaken; possibly he made out this part of the vascular system from some Tubificid. — The dorsal vessel runs ventrally, to the left of the intestine, from VI backwards.

The nephridia show a fairly remarkable character. For a great part of their length, their ducts are closely packed together, enveloping the ventral vessel (Pl. V, fig. 1). Usually there is only one nephridium per segment, but if two are present, both show this feature. Their funnels look quite normal, and their external openings lie in front of the corresponding ventral setal bundles. Only once did I see a nephridium with an entirely free loop. The first nephridium is usually in VIII.

The clitellum begins immediately behind the spermathecal apertures; its front limit runs obliquely, from the segment border 4/5 dorsally to about the middle of the segment ventrally.

The testes are fairly large, and irregularly oblong, about 70 μ high. They are fixed to the posterior face of septum 4/5. — The ovaries, on the posterior face of septum 5/6, are much smaller, about 40 μ at their longest. Testes and ovaries soon disappear.

The spermathecae (Pl. IV, fig. 1) are unusually small, even when filled with sperm. The ampulla is either spherical, about 70 μ in diameter, or elongated, about 100 μ long, 45 μ in diameter. The wall is thin. The spermathecal ducts are sharply distinct, with walls of columnar cells, about 70 μ long, 20 μ broad, with a very narrow lumen. They make a sharp outward bend, and open in the lateral wall of V, behind septum 4/5 (cf. Fig. 26 *D* and SPERBER, 1939, Fig. 2).

The male funnels (Pl. IV, fig. 2) face obliquely backwards into the sperm-sac. Their diameter is about 30 μ, their walls are thick, consisting of high cells. The vasa deferentia (Pl. IV, fig. 3), about 180 μ long, are narrow below the funnel, about 13 μ wide, with thin walls, about 5 μ thick, consisting of epithelial cells of the common appearance, with nuclei. Behind septum 5/6 they broaden considerably, to about 25 μ, the walls become 10 μ thick, consisting of large, faintly staining cells, of a glandular appearance (cf. p. 48). Immediately before the opening into the atria they narrow again, to 13 μ. They are surrounded by masses of large prostate gland cells, behind septum 5/6. They make a wide outward bend, pass outside the pockets, and open from the outer side into the lower, anterior part of the atria (cf. SPERBER, 1939, Fig. 2 *B*), close to the atrial ducts.

The atria (Pl. IV, figs. 4, 5) are small, spherical, 65 μ in diameter, or oval, up to 105 μ long, with thin walls when extended (about 6.5 μ), consisting of an apparently not, or very faintly, glandular epithelium and a fairly strong muscular layer, without prostate gland cells. The ejaculatory duct (Pl. IV, fig. 4) is very short, consisting of the same sort of cells as the ampulla. It leaves the lower face of the atrium, and passes downwards and forwards to join the pocket in the body wall at the middle of its height. The pocket is about 60 μ deep, and as broad, and lined by a fairly thin, columnar epithelium (Pl. IV, fig. 4 *p*). The pocket is connected with the upper body wall by a strand of muscle-fibres (Pl. IV, fig. 4 *pm*; cf. Fig. 26 *D*). It is eversible; probably the pockets are everted during copulation to make the openings of the atrial ducts meet the lateral openings of the spermathecae. — The penial setae are about 80 μ long, straight, of the common shape, with a simple hook. They are situated closely in front of, and medially to, the pockets, projecting almost vertically downwards (Pl. IV, fig. 4 *ps*).

The female funnels (Pl. IV, fig. 6) are inconspicuous, situated laterally in the body-wall, in front of septum 6/7. — The sperm-sac extends back through VII, the ovisac into VIII, at the most mature stage examined. The blood-supply to the sperm-sac and ovisac is very plentiful, and is brought about by large, winding vessels along the inside of the sacs. The intestinal sinus, too, is strongly developed during maturity (cf. p. 37).

I have found this species in the surface layer of bottoms of mixed sand and clay, not deeper than 0.1—2 m (Piguet reports it from 3—28 m).

Uncinais Levinsen, 1884.

Generic type: *Uncinais uncinata* (Ørsted).

Eyes present. Dorsal setae from VI on, double-pronged crotchets only; ventral setae all of one type. A stomachal dilatation present; pharyngeal and oesophageal gland cells present. Dorsal vessel to the left. Coelomocytes present. Clitellum absent round male pores; vasa deferentia with prostate gland cells, joining atria immediately above atrial duct; atria without prostate, duct poorly defined; penial setae present.

Uncinais uncinata (Ørsted, 1842).

Fig. 26 *G*; Pl. V, figs. 2–4.

Nais uncinata Ørsted, 1842, p. 136.
Nais uncinata Ørsted. Grube, 1851, p. 104. Tauber, 1879, p. 75. Timm, 1883, p. 154.
Paranais uncinata (Ørsted). Czerniavsky, 1880, p. 311. Michaelsen, 1900, p. 19; 1903 b, pp. 170—171; 1909 a, p. 12; 1923, p. 31; 1926 c, p. 3; 1927 a, p. 9. Piguet, 1906, pp. 194—200, Pl. IX, figs. 1—7; 1909, pp. 173—174, Pl. III, fig. 1; 1919 a, p. 789. Piguet & Bretscher, 1913, pp. 16—17. Wolf, 1928, p. 389, Fig. 4. Malevich, 1929, pp. 43—44. Ude, 1929, p. 26.
Uncinais uncinata (Ørsted). Levinsen, 1884, p. 218. Beddard, 1895, p. 296. Bretscher, 1899, pp. 392—393.
? Ophidonais uncinata (Ørsted). Vejdovsky, 1884, p. 24.
Ophidonais uncinata (Ørsted). Vaillant, 1890, pp. 355—356.

Dorsal setae 2—4 per bundle, slightly shorter than ventral, with nodulus distal; ventral setae 2—7 per bundle, those of II longer than the rest, with nodulus proximal;

behind VI nodulus distal; all setae with distal tooth longer, and proximal tooth thicker. Stomach beginning in VIII. Transverse vessels in II –V forming a net-work; a network in the body wall in I—VIII; dorsal vessel to the left. Clitellum in V—VIII; spermathecal ampulla roundish or ovoid, duct fairly long, well-defined; vasa deferentia straight, with sparse prostate cells, joining atria immediately above atrial duct; atria very small, sometimes opening into a pit; penial setae with a simple hook; female funnels unusually large. $n = 19—27$. $s = 31—54$. $l = 5—18$ mm. Body tapering backwards.

Europe, Turkestan. Found in brackish water also (the Baltic).

Sweden: Waters in Småland, Närke, Lapland (ALMSTEDT, 1946); Lapland, Sarek: small lake at Tjågnoris (S. BERGSTRÖM coll., PIGUET 1919); Viggsjön (I. ARWIDSSON coll.); Sandvikssjön, Rengen (S. BERG coll.); Ekoln, Skedviken, Fyrisån, Hågaån, Siljan, Hällsjön, Övre Hågåsjön, Storån, Lilla Gladaviken, Älgträsket.

The seta measurements of a specimen from lake Siljan were: ventral setae of II, 120—126 μ long, behind VI, 105—110 μ, dorsal setae 99—102 μ. – The measurements given by PIGUET are: ventral setae of II, 125 μ, of posterior segments 96—108 μ, dorsal setae 86—98 μ; no other measurements have been found in the literature.

The vascular net-work along the body wall in the anterior segments, reported by BRETSCHER (1899) is undoubtedly present. — As to the sexual organs (Fig. 26 *G*, p. 249), the most striking feature is their small size in relation to the body size. The gland cell layer round the vasa deferentia may vary considerably in density; it may be very scanty, but is often strong round the opening into the atrium. The peritoneal covering of the atria is fairly thick, but not glandular. The atrial epithelium does not seem to be glandular. I could not find the pit into which the atrium was stated by PIGUET to open. Below are some measurements from a specimen at an advanced stage of maturity: spermathecal ampulla (Pl. V, fig. 4) 40—50 μ in diameter, with wall 3—10 μ thick; spermathecal duct about 60 μ long, 25 μ in diameter. Male funnels 35 μ long, 30 μ in diameter; vasa deferentia about 95 μ long, 8—10 μ in diameter; atrial ampulla (Pl. V, fig. 2) about 50 μ high, 35—50 μ in diameter; ejaculatory duct 22 μ long, 18 μ in diameter; penial setae 110 μ long. Female funnels 30 μ in diameter (Pl. V, fig. 3).

About the re-erection of the genus *Uncinais* see p. 83.

Ophidonais Gervais, 1838.

Generic type: *Ophidonais serpentina* (Müller).

Eyes present. Body wall with scattered papillae. Dorsal setae from VI, all stout, straight needles; ventral setae, all of one form. Pharyngeal and oesophageal glands present; stomachal dilatation present. Vascular system with transverse commissural vessels in II-V, simple or anastomosing; dorsal vessel in the middle line. Coelomocytes present. Clitellum absent round male pores; vasa deferentia, covered with prostate glands, joining atria immediately above atrial duct; atria devoid of prostate gland cells, atrial duct poorly defined; penial setae present.

Ophidonais serpentina (Müller, 1773).

Figs. 10, 26 *F*; Pl. V, fig. 5, Pl. VI, fig. 1.

Das Mercurschlängelein Rösel von Rosenhof, 1755, pp. 568–578, Pl. XCII, figs. 1—13.

Die geschlängelte Naide Müller, 1771, pp. 84—89, Pl. IV, figs. 1—4.

Nais serpentina Müller, 1773, pp. 20—21.

Nais serpentina Müller. Gmelin, 1788—1793, p. 3121. Modeer, 1798, pp. 121—123. Oken, 1815, p. 364. Lamarck, 1816, p. 223. Blainville, 1825, p. 129; 1828, p. 498. Tabl. enc. méth., 1827, p. 134, Pl. LIII, figs. 1—4. Johnston, 1845, p. 443. Grube, 1851, p. 104. d'Udekem, 1855, pp. 551—552; 1859, p. 21. Lankester, 1869 c, pp. 102—104; 1871, pp. 99—101. Tauber, 1879, pp. 74—75. Timm, 1883, p. 154. Levinsen, 1884, p. 220. Beddard, 1895, pp. 285—286. Bretscher, 1896, pp. 507—508. Smith, 1900, p. 443.

Ophidonais serpentina (Müller). Gervais, 1838, pp. 19–20. Vejdovsky, 1883, p. 217; 1884, p. 27, Pl. III, figs. 14—16. Stolč, 1886, pp. 503—504. Vaillant, 1890, pp. 354—355, Pl. XXIII, fig. 12. Bourne, 1891, p. 345. Michaelsen, 1900, p. 22; 1903 b, pp. 172—175, Figs. 1—2. Piguet & Bretscher, 1913, pp. 22—23. Schuster, 1915, pp. 9—14, 65—66, Figs. 1—4. Smith, 1918, p. 639. Wolf, 1928, pp. 388, 402. Ude, 1929, pp. 27—28, Figs. 21—24. Cordero, 1931, p. 349.

Serpentina quadristriata Ørsted, 1842, pp. 134—135.

Serpentina quadristriata Ørsted. Johnston, 1865, p. 70.

Slavina serpentina (Müller). Bousfield, 1886 a, pp. 266—268, Pl. XXXIII, fig. 5.

Ophidonais reckei Floericke, 1892, pp. 469—470.

Nais reckei (Floericke). Beddard, 1895, p. 289.

Ophidonais reckei Floericke. Michaelsen, 1900, p. 23; 1909 a, p. 11. Southern, 1909, pp. 132—133, Pl. VII, fig. 1.

Ophidonais serpentina (Müller) var. *meridionalis* Piguet, 1906, pp. 206—214, Pl. IX, figs. 8—17.

Ophidonais serpentina (Müller) f. *typica*. Michaelsen, 1909 a, p. 11. Pointner, 1914 b, p. 98. Svetlov, 1926 a, pp. 250—251.

Ophidonais serpentina (Müller) var. *meridionalis* Piguet. Michaelsen, 1909 a, p. 11, Figs. 14—15. Piguet & Bretscher, 1913, p. 24. Svetlov, 1926 a, p. 251. Malevich, 1927, p. 5; 1929, p. 44.

Ophidonais sp. Kleiber, 1911, pp. 22—23.

Anterior end of body with 3—4 transverse pigment stripes. Body-wall with sensory papillae; often a thin crust of foreign particles. Dorsal setae 1 per bundle, very stout, with blunt, double-pointed or simple distal end; ventral setae 2—6 per bundle, with longer distal prong, those of II longer than the rest, in II—V with nodulus proximal or median, in the following segments nodulus median or distal. Pharynx stretching into IV; stomachal dilatation in VIII–X or IX—XI. Transverse vessels in II—IV, or II—V, simple or anastomosing. Clitellum in V—VII or V—VIII; spermathecal ampulla thin-walled, elongated, sometimes entering the sperm-sac, duct long, narrow; vasa deferentia long, winding, with thick prostate covering; atria small, ejaculatory duct short, indistinct; penial setae 2—3 per bundle, distal end broadened or forming a simple hook; filamentous spermatophores formed. $n = 23—51$. $s = 35—97$. $l = 6—36$ mm.

Europe, N. and S. America.

Sweden: Waters in Närke and Uppland (ALMSTEDT, 1946); Bondkroken (I. ARWIDSSON coll.); Brunnsviken, Valloxen, Ekoln, Metsjön, Trehörningen, Fyrisån, Hågaån.

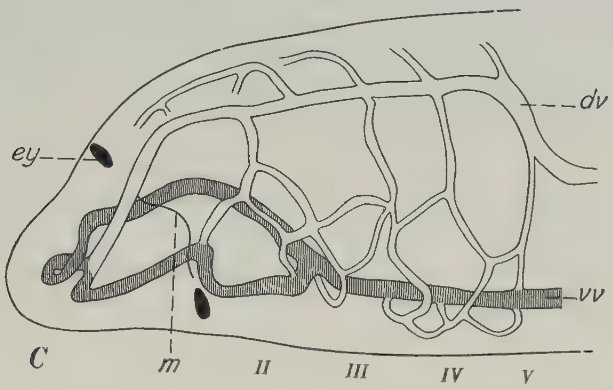

Fig. 10. *Ophidonais serpentina*. Vascular system in the anterior segments. *dv* dorsal vessel, *ey* eye, *m* mouth, *vv* ventral vessel.

PIGUET's var. *meridionalis* can hardly be a geographical race, being found in Switzerland and Russia, in the same districts as the main form (SVETLOV, 1926 a, found them in different waters, though). It might be two species, but SCHUSTER (1915) found specimens showing the vascular system of the main form (transverse vessels in II—IV, non-anastomosing), but the sexual characters (shape of spermathecae) of the variety, so most probably the latter represents only a modification. I found a form in Sweden with very complicated anastomoses in II—V, thus representing the "var. *meridionalis*" (Fig. 10). The seta measurements; ventral setae of II 147—150 μ, the rest 114—120 μ, needles 150—168 μ, agree very well with those given by SCHUSTER, but less well with those given by PIGUET for the "var. *meridionalis*," which are considerably larger ventrally (179 μ, resp. 141—158 μ). The tips of the needles were simple, like those reported by SOUTHERN (1909).

The extreme seta measurements found in the literature are: ventral setae of II, 152—179 μ, posterior ventral setae 114—158 μ, dorsal setae 128—158 μ.

SCHUSTER reported swimming in his specimens. PIGUET's, however, did not swim, and neither did mine.

For details of the alimentary canal see the anatomical section.

Nais Müller, 1773.

Generic type: *Nais barbata* Müller.

Eyes normally present. Anterior segments usually pigmented. Ventral setae of II—V mostly well differentiated from those of the following segments; dorsal setae beginning in VI, hairs and double- or simple-pronged needles. Pharynx in II—III; pharyngeal and oesophageal glands present; stomach beginning in VII (occasionally VIII). Vascular system with simple or anastomosing transverse vessels in I—V. Coelomocytes present. Clitellum in 1/2 V—VII, absent between the male pores; spermathecae with distinct ducts; vasa deferentia with prostate glands, joining atria immediately above atrial ducts; atria without prostate; penial setae present, with a simple or double hook.

The genus, as created by Müller contained only 2 species now placed within it, *N. elinguis* and *N. barbata*. As it is not clear what the former comprised, I have chosen the latter as type of the genus.

Nais communis Piguet, 1906.

Pl. VII, fig. 1.

[*?*] *Die zungenlose Naide* Müller, 1771, pp. 74—79, Pl. II [*? partim*].
[*?*] *Nais elinguis* Müller, 1773, p. 22 [*? partim*].
[*?*] *Nais elinguis* Müller [*? partim*]. Müller, 1776, p. 219. Gmelin, 1788—1793, p. 3121. Modeer, 1798, pp. 130—133. Blainville, 1825, p. 131; 1828, p. 498. Tabl. enc. méth., 1827, p. 134, Pl. LIII, figs. 9—11. Ørsted, 1842, p. 135. Grube, 1851, p. 104. d'Udekem, 1855, p. 551; 1859, p. 20. Tauber, 1879, pp. 73—74. Czerniavsky, 1880, p. 308. Timm, 1883, pp. 140—154, Pl. XI, figs. 20, 22. Levinsen, 1884, p. 219. Dieffenbach, 1885, pp. 98—104. Stolč, 1886, pp. 502—506. Vaillant, 1890, pp. 369—370, Pl. XXIII, fig. 11. Bourne, 1891, p. 344. Benham, 1892, pp. 212—213, Pl. VII, figs. 38—41. Beddard, 1895, p. 284. Ferronière, 1899, pp. 254—255. Smith, 1900, p. 443; Michaelsen, 1900, p. 25. Moore, 1905 a, p. 166. Munsterhjelm, 1905, p. 13. Galloway, 1911, p. 303.
[*?*] *Opsonais elinguis* (Müller). Gervais, 1838, p. 17. [*? partim*]
Nais heterochaeta Benham, 1893, pp. 383—396, Pl. XXXIII, figs. 1—5.
Nais communis Piguet, 1906, pp. 247—253, Pl. X, fig. 9, Pl. XI, figs. 14—17, 19, Pl. XII, fig. 11.
[*?*] *Nais parvula* Walton, 1906, pp. 697—698, Fig. 7.
Nais parviseta Walton, 1906, p. 699, Fig. 9.
Nais communis Piguet. Michaelsen, 1909, p. 18, Fig. 25. Piguet, 1913, pp. 116—117; 1928, pp. 80—81. Piguet & Bretscher, 1913, pp. 37—38. Schuster, 1915, pp. 41—42, 73—74, Fig. 27. Smith, 1918, p. 639. Stephenson, 1922 a, p. 255; 1932, p. 231. Svetlov, 1924, p. 193. Stolte, 1927, pp. 1—47, Figs. 1—20. Ude, 1929, pp. 46—47, Fig. 56. Michaelsen & Boldt, 1932, p. 591. Redeke & de Vos, 1932, p. 15. Szarski, 1936 b, pp. 389—392, 394—396, Pl. XVIII, figs. 1—5, 9. Preu, 1937, pp. 258—279, Figs. 1—13. Wesenberg-Lund, 1938, pp. 7—13. [?] Chen, 1940, pp. 33—34, Fig. 4. [?] Marcus, 1943, pp. 21—23, Pl. I, fig. 5, Pl. II, figs. 6—8.

Nais variabilis var. *punjabensis* STEPHENSON, 1909 a, pp. 255—263, Figs. 1—3, Pl. XV, figs. 1—8, Pl. XVI, figs. 9—18.
Nais variabilis var. *punjabensis* Stephenson. STEPHENSON, 1910 a, pp. 66—68, Pl. VIII, figs. 1—2.
Nais communis var. *punjabensis* (Stephenson). PIGUET, 1909, pp. 198—202, Fig. STEPHENSON, 1910 b, pp. 237—238, Pl. XI, figs. 2, 4; 1918, p. 12; 1920, pp. 196—197; 1923, pp. 55—57, Figs. 11, 12; MICHAELSEN & BOLDT, 1932, pp. 591—592.
Nais communis var. *caeca* STEPHENSON, 1910 b, pp. 238—240, Pl. XI, fig. 3.
Pterochaeta astronensis PIERANTONI, 1911, pp. 4—6, Pl. IV, figs. 1—12.
[*non*] *Nais communis* Piguet. SOUTHERN, 1913, p. 4.
[*?*] *Nais communis* var. *acuta* POINTNER, 1914 b, p. 101.
Nais communis var. *caeca* Stephenson. STEPHENSON, 1918, p. 12; 1923, pp. 57—58, Fig. 13; 1925 c, pp. 44—45.
[*non*] *Nais communis* Piguet. STEPHENSON, 1931 b, p. 39.
[*?*] *Nais communis* Piguet f. *magenta* MARCUS, 1943, p. 23, Pl. II, fig. 8.

Eyes sometimes absent. Usually brown pigment in I—V. Ventral setae 2—6 per bundle, those of II—V with median nodulus, hardly longer and slightly straighter and thinner than the rest — here nodulus distal; needles 1—2 per bundle, with nodulus often inconspicuous, 1/5—1/3 from the distal end, and with teeth short, diverging, usually distinct; hairs 1—2 per bundle. Stomach slowly widening. Commissural vessels of I—V with frequent anastomoses; dorsal vessel to the left. Nephridial funnel with oblique border, glandular part long. Spermathecal ampulla large, reaching back through VI, proximal part bag-like, distal part tubular, duct narrow; vasa deferentia thick, with prostate only on their posterior part; atrial ampulla roundish, duct about as long as ampulla, swollen beneath the opening of the vas deferens; penial setae 2—3 per bundle. $n = 10—21$. $s = 12—32$. l (simple) = 1.5—6.5 mm, (chains) = 1.8—12 mm. No swimming.

Cosmopolitan. Found also in brackish water (the Netherlands).

Sweden: Småland: Fiolen (ALMSTEDT, 1946); Vättern (EKMAN, 1911); Lövsjön (S. BERG, coll.); Brunnsviken, Fyrisån, Siljan, Åkerö tjärn, Dalälven, Storån, Foskan, Älgträsket, Lilla Gladaviken, Kräkångersselet, many ponds and rivulets.

Before PIGUET (1906) described the main outlines of the taxonomy of the genus *Nais*, there was great confusion of nomenclature, a good deal of what was described under the name of *Nais elinguis* no doubt being in fact *Nais communis*, *N. variabilis*, or yet other species; usually it is impossible to judge which species (one or several) a certain author has dealt with. — It is possible that *N. elinguis* of O. F. MÜLLER was *N. communis*.

I find it highly probable that BENHAM'S (1893) *Nais heterochaeta* is identical with the present species. The body length agrees (1/4 inch = about 6 mm), eyes are present, and the stomach widens slowly. The ventral setae (op. cit., Fig. 3) are 3—5, all about equal, only the distal tooth being longer in II—V. The needles (op. cit., Fig. 2), 1 per bundle, 45 μ long, are fairly strongly bent (probably somewhat exaggerated in the fairly primitive drawing), with distinct teeth, both the latter characters typical for *N. communis* (cf. PIGUET, 1906, Pl. XII, fig. 11 a). The hair setae are 1 per bundle, only about 165 μ long. The vascular system is somewhat more complicated than usual, but *N. communis* is the species where complications are most frequent. PIGUET (op. cit., p. 251) remarks: "Mais, chez *N. communis,* il y a fréquemment de nombreuses et longues anastomoses, faisant communiquer les anses entre elles ou avec le vaisseau dorsal;". *N. heterochaeta* is stated to have a pair of vessels in VI, too, — this seems dubious. — BENHAM states that the ventral vessel divides in V, whereas PIGUET states III; this character in fact varies. — The nephridia are unpaired, one nephridium frequently occupying two segments. This state of things does not seem to have been recorded elsewhere in the literature, but I often saw it in *N. communis* (see below). Their appearance wholly corresponds with the characteristic nephridia of this species (cf. PIGUET, 1906, Pl. XI, fig. 15). — As the name *Nais heterochaeta* has priority, the species ought to retain this name, but as *N. communis* has always been the current name, I propose to retain it as a *nomen conservandum.*

The species *Nais parviseta* Walton (1906) also seems to be *N. communis.* PIGUET (1913, p. 177, foot-note) suggests that it may be identical with *N. pardalis,* but this seems to me less probable on account of the stomach which widens slowly in WALTON's specimens. The characters given are unsatisfactory, yet some can be deduced from the figure (op. cit., Fig. 9). The ventral setae, 3—4 per bundle, are stated to have the "lower tooth considerably larger than the upper tooth," but in the figure the reverse is shown. WALTON, however, adds: "The characteristic differentiation of the teeth on the ventral setae appears to be of considerable specific importance," so possibly the figure is wrong, or the posterior setae are shaped otherwise. Measurements show that they are (in IV) 68—72 μ long, which fits well. The needles are curved, with distinct teeth, the one in the picture being 66 μ long. The hair shown is about 195 μ long. $l = 3.5$ mm. $s = 19—20$.

Nais parvula Walton is very small, $s = 9—10$, $l = 1.2$ mm (1.36 in WALTON's Fig. 7), and is stated to have "digestive tract not differentiated into oesophagus and stomach." He remarks: "At first it seemed probable that it was an immature form but evidence to the contrary was given by budding in several specimens." Yet it seems reasonable that he had prematurely separated specimens which had not obtained a dilated stomach (cf. p. 6). The ventral setae, 6—7 per bundle, as measured from the figure seem to be 50—70 μ lóng in VI, with the distal tooth slightly longer or equal to the proximal one. It is most satisfactory to regard it as *N. communis* (although it may be e. g. *N. variabilis*), so much the more so if *N. parviseta* belongs to this species. Also, *N. communis* has been recorded from N. America by other authors (HAYDEN, SMITH, ALTMAN) whereas WALTON's species seems never to have been met with again. This is not astonishing; in fact, all his new species are extremely doubtful, the whole study having been carried out, as he remarks, during only six weeks, most of the time being occupied with other work.

Nais communis var. *acuta* Pointner seems doubtful. It cannot be a geographical race of *N. communis*, being found at the same locality ("Mittersee: Im Holzgeschabe"). The only general difference from *N. communis* seems to be the length of the hairs, $4^1/_2$ times the length of the needles. Either it is only an occasional form of *N. communis*, or possibly *N. variabilis*, nothing being mentioned about stomach or swimming. The statement: "Das Gehirn zeigt nur einen unpaaren, mittleren Lappen" seems obscure.

I have also included STEPHENSON's two varieties, *punjabensis* and *caeca*, as I can see no reason for maintaining them. The differences between the var. *punjabensis* and the type form are summarized by STEPHENSON (1923) as follows: "In the type form the whole body is yellowish red or pale brownish; the prostomium is fairly long, twice as long as broad at the base; all the ventral setae have a markedly longer distal prong; in the dorsal needles the forking is very easy to see (which is not at all the case in the var. *punjabensis*), and the prongs diverge almost at a right angle; the spermatheca does not appear (from the figure) to be contained in the sperm-sac in segment vi, as it is in the present form." The last statement is erroneous (cf. PIGUET, 1906, Pl. XI, fig. 19); as regards the others, the pigmentation may be very weak in the main form, too (cf. e. g. SCHUSTER, 1915, p. 42), the form of the prostomium is not constant, either; as regards the distal prong of the posterior ventral setae, it is often as long as the proximal in the main form (cf. below). The prongs of the needles, too, are far from always so strong and so diverging as in PIGUET's figure (1906, Pl. XII, fig. 11; cf. below). — As the main form was also found in the same regions as the var. *punjabensis*, there is no reason to assume it to be a geographical race.

The "var. *caeca*" differs from the "var. *punjabensis*" in nothing but the absence of eyes, and was often found together with it. Eyeless forms are recorded by other authors, too, especially WESENBERG-LUND (1938).

As to *Nais communis* Piguet of SOUTHERN (1913) and STEPHENSON (1931 b) see pp. 108 and 130.

The most characteristic features of *Nais communis* are the slow widening of the stomach, the fact that it never swims, contrary to most other species of the genus, and the unusually small difference in length and shape between the ventral setae of II—V, and the rest (cf. PIGUET, 1906, Pl. XII, fig. 11 b, c). The former are hardly longer, somewhat straighter, and slightly thinner than the rest (about 1.5 μ thick against about 2 μ), with a median nodulus, while the rest have a slightly distal one. The distal tooth is about twice as long as the proximal one in the anterior segments, eventually growing shorter towards the rear, while the proximal one grows slightly longer, so that in the hindmost segments the two teeth may even be equally long. As a rule, the distal tooth in the anterior segments is about 4.5—5 μ long, the proximal one 3—3.5 μ, both approximating to 4—4.5 μ posteriorly. The needles, both the part distal to the nodulus, and that proximal to it, may be more strongly curved than in most of the species, but they may be almost straight. They are about 1.5 μ thick, the teeth 1—1.5 μ long. The nodulus is often weak, and is usually situated about 1/5 from the distal end, but not infrequently 1/3 — in this case the setae are often less curved. Below I give a couple of examples of setal lengths in μ, that I have found:

	v. s. II	v. s. III	v. s. IV	v. s. V	v. s. VI	v. s. post.	n. s.	h. s.
a)	69–77	70–74	66–69	66	62–64	59–64	50	125–150
b)	65–67	61–64	64–65	64–65	65	65–67	54–55	140–170

The extremes that I have found are: ventral setae in II, 63—93 μ, in V, 59—66 μ, in the remaining segments, 54—78 μ, needles 40—78, hairs 90—255 μ; those found in the literature are: ventral setae of II—V, 59—93 μ, the rest 54—90 μ, needles 43—80 μ, hairs 125—268 μ; penial setae 89 μ.

As mentioned above, I have noticed that the nephridia are often unpaired; one nephridium may often reach through 2 segments, or pass under the intestine, forming a loop on the opposite side, too.

I never saw the sexual organs of this species. (See Piguet, 1906, pp. 251—253, Pl. XI, figs. 16—17, 19.)

Nais communis Piguet of Chen (1940) has ventral setae of II—V about 125—135 μ long, thinner than the rest, those of the following segments being 95—105 μ, needles mostly 1 per bundle, almost straight, with fine teeth, and hairs 1 per bundle, up to 200 μ long. The setae are longer than any reported for *N. communis*, and the difference in length between those of II—V and the following is much greater, about 30 μ. Nothing is mentioned about the stomachal dilatation. The spermathecal ampulla only occasionally presents the shape found in *N. communis*, apparently usually being bag-like. The duct is widened, as in *N. variabilis*. The distribution of the prostate gland cells on the vasa deferentia resembles that found in *N. communis*, but the vasa join the atria a fairly long way above the atrial duct (if this character really holds true, not being found elsewhere in the genus). The atrial wall is not swollen below the opening of the vas deferens. The penial setae are 88 μ long, 3.5 μ thick, often bifid. No swimming seems to occur. n was $= 16—17$, $s = 20—34$, $l = 4—12$ mm. — It differs from the general habit so much, that it cannot possibly represent the common form. It may be a new species but as yet there is no objection to the possibility of its being a geographical race. I have deduced the characters from Chen's not altogether satisfactory statements, and from his Fig. 4 — the points about the sexual organs depending on the accuracy of the figure.

Chen finds it questionable whether *N. communis* and *N. variabilis* are really two different species, the characters separating them being variable or inconstant. This insecurity is no doubt due to the presence in China of the present form which seems to be somewhat intermediate between the two, for between the main forms the differences are wholly significant and unmistakable (cf. p. 108).

The *Nais communis* reported by Marcus from Brazil seems somewhat doubtful. The setal characters agree very well, also the shape of the stomach, and the vascular system (anastomosing transverse vessels). The sexual organs, however (loc. cit., Pl. II, fig. 7), are aberrant, and much more like those of *Nais barbata* or *pseudobtusa*, e. g., with the swollen spermathecal duct, the abundant prostate glands on the whole length of the vasa deferentia, and the round atrial ampulla and well differentiated duct. Possibly it represents a new species. It may, however, be a strongly differentiated geographical race, as the common form does not appear to have been recorded from S. America. The distribution of the several forms, however, is as yet not sufficiently known to allow of any well-founded conclusions, so I do not propose any new names.

Nais communis f. *magenta* Marcus with red eyes, and a smaller number of shorter setae, does not seem to be taxonomically different from the other Brazilian form, according to modern nomenclature.

Nais variabilis Piguet, 1906.

Pl. VI, fig. 3, Pl. VII, fig. 2.

[?] *Nais elinguis* Müller. [? *partim*] of several authors (see *N. communis*).

[?] *Nais rivulosa* Leidy, 1850, pp. 43—44, Pl. II, fig. 2.

[?] *Nais rivulosa* Leidy. Minor, 1863, p. 36. Vaillant, 1890, pp. 370—371.

Nais elinguis Müller. Vejdovsky, 1883, p. 218; 1884, pp. 28—29, Pl. II, figs. 16—22, Pl. III, figs. 5, 6. Stolč, 1886, pp. 504—506.

Nais variabilis Piguet, 1906, pp. 253—260, Pl. X, figs. 10—18, Pl. XI, figs. 18, 20, 21, 23, Pl. XII, figs. 12—13.

Nais variabilis Piguet. Piguet, 1909, pp. 195—198, Pl. III, figs. 9—11; 1928, p. 81. Michaelsen, 1909 a, p. 19, Fig. 26; 1926 a, p. 21. Piguet & Bretscher, 1913, pp. 38—39. Schuster, 1915, pp. 42—43, 74. Stolte, 1921, pp. 538—547. Stephenson, 1922 b, p. 280. Svetlov, 1924, pp. 193—194; 1926 a, p. 251. Malevich, 1927, p. 7; 1929, pp. 46—47. Wolf, 1928, pp. 395, 406. Ude, 1929, pp. 47—48, Fig. 57. Redeke & de Vos, 1932, p. 16. Kondô, 1936, pp. 384—385, Pl. XXIII, fig. 10. Szarski, 1936 b, p. 396, Pl. XVIII, fig. 16. Černosvitov, 1930, p. 10; 1937 b, pp. 144—145; 1938 b, p. 269. Hrabě, 1939, p. 221.

[?] *Nais communis* Piguet. SOUTHERN, 1913, p. 4.
[?] *Nais japonica* KONDÔ, 1936, p. 385, Pl. XXIII, fig. 12.

Pigment in I—V present or absent. Ventral setae 2—7 per bundle, those of II—V with nodulus slightly proximal or median, longer, straighter and thinner than those of the following segments; the rest with distal nodulus; hairs and needles 1—2 per bundle, needles with conspicuous nodulus, at 1/6—1/3 from the distal end, teeth short but obvious. Stomachal widening abrupt. Dorsal vessel to the left of the middle line. Glandular part of nephridia short. Spermathecal ampulla ovoid, confined to V, duct strong, dilated; vasa deferentia completely surrounded by strong gland cells; atria pear-shaped, atrial duct usually short, narrow or swollen; penial setae 2—3 per bundle. $n = 12—21$. $s = 18—38$. $l = 3—10$ mm. Swims with spiral movements.

Cosmopolitan. Found also in brackish water (the Netherlands).

Sweden: Waters from Scania to Lapland (ALMSTEDT, 1946); Båven (N. VON HOFSTEN coll.); pond at Mariefred (I. ARWIDSSON coll.); Brunnsviken, Ekoln, Siljan, Åkerö tjärn, Dalälven, Hällsjön, Vallsträsket, Kräkångersselet, Kyrksjön, Missjön, many ponds and lakelets.

The species was formerly confused with several others under the name "*Nais elinguis*" (cf. the list of synonyms under *N. communis*). The *N. elinguis* of VEJDOVSKY and ŠTOLC are, however, no doubt only *N. variabilis.*

Nais rivulosa Leidy (1850 b) is probably also *N. variabilis.* The stomachal dilatation is abrupt; the ventral setae, 5—6 per bundle, are $^1/_{250}$ inch (about 100 μ) long; the hairs, 2 per bundle, are $^1/_{75}$ inch (340 μ); the latter are too long for *N. bretscheri* or *pardalis*, too few for *N. barbata* or *pseudobtusa.* $l = 7$ lines (about 14 mm).

Nais communis Piguet of SOUTHERN (1913) is probably *N. variabilis*, as it is stated to swim actively.

Nais japonica Kondô (1936) is remarkable, having no eyes, and dorsal bundles from V onwards. The stomachal dilatation is gentle; the setae seem to resemble those of *N. communis* or *N. variabilis.* Possibly it may represent abnormal or prematurely separated individuals of the latter, as it was found together with it.

The habit of a *N. variabilis* with unusually long hair setae is shown in Pl. VI, fig. 3. — The species is extremely variable in size, pigmentation, size of setae (both in different specimens, and within the same animal), and also in the shape of the setae. (It should be emphasized that this great variability in setal characters is a very rare thing among Naids.) Yet it is always easily recognized, from its sudden stomachal dilatation (I always found this character to hold true, except in newly-budded specimens), its hair setae, which are nearly always longer and stronger than those of *N. communis*, and its readiness to swim. I cannot confirm CHEN's (1940, p. 34) opinion, that the differences between *N. variabilis* and *N. communis* are inconstant (cf. p. 107).

As to the setae, I have found specimens referable to all three of PIGUET's varieties (PIGUET, 1906), as well as transitional forms of all gradations. I examined a great number of specimens, especially from a pool in the forest near Uppsala. The following examples are all from this pool. — The table below shows the setal size in μ of a specimen, which ought to be referred to PIGUET's "variété des grands lacs," though the length of the setae is rather small (compare with PIGUET's table of the relative lengths in his specimens from the Lake of Neuchâtel):

	v. s. II	v. s. III	v. s. IV	v. s. V	v. s. VI	v. s. post.	n. s.	h. s.
length	96–104	93–100	93–100	91–96	78–80	77–82	ab.66	200–435
thickn.	2	1.8	1.8	1.8	3	2.7–3	1.3	
teeth	$\frac{7}{3.5}-\frac{8}{4}$	$\frac{7}{3.5}-\frac{8}{4}$	$\frac{7}{3.5}-\frac{8}{4}$	$\frac{7}{3.5}-\frac{8}{4}$	$\frac{6.5}{5}-\frac{8}{4}$	$\frac{5.5}{5}-\frac{6.5}{5}$		

In the following specimen, the difference in length between the setae is greater, the setae of II—V are much stouter, and their proximal prong is much longer:

	v. s. II	v. s. III	v. s. V	v. s. VI	v. s. post.	n. s.	h. s.
length.......	104–107	96–99	86–88	77	67–70	51	285–485
thickn.......	3	2.4–2.8	2.4–2.8	2.5–3	2.5–2.7	1.3	
teeth........	$\frac{7}{6\text{–}7}$	$\frac{6.4}{5.3\text{–}6}$	$\frac{6.4}{5.3\text{–}6}$	$\frac{6.4}{5.3\text{–}6}$	$\frac{5.1\text{–}6.4}{5.1\text{–}6}$		

In the first case the form of the needles was that figured by PIGUET for the "forme type" (op. cit., Pl. XII, fig. 12 a) with the nodulus about 1/5 from the distal end, in the latter it resembled that of the "variété des grands lacs" (op. cit., Pl. XII, fig. 13 a), with the nodulus 1/3 from the end. Below I give a table for a specimen agreeing with the "forme type":

	v. s. II	v. s. III	v. s. IV	v. s. V	v. s. VI	v. s. post.	n. s.	h. s.
length	78–79	69–78	71–73	69–73	66–69	64–69	52–60	195–285
thickn.	1.5–1.7	1.7	1.7	1.7	2.2	2.5	1.7	
teeth	$\frac{5.2}{3.4\text{–}4.2}$	$\frac{4}{3\text{–}4}$	$\frac{4.2\text{–}4.8}{4.2}$		$\frac{4.6\text{–}5}{4.2}$	$\frac{4.8}{5\text{–}5.2}$	$\frac{2}{2}$	

This particular specimen had the distal tooth of the posterior ventral setae even shorter than the proximal tooth, but it may also be longer. The nodulus of the needles was about 1/4—1/3 from the distal end. As pointed out above, specimens showing varying transitional forms of all the characters, absolute and relative length and thickness of setae and teeth, were also found. Thus, there seems to be no reason to maintain a special "var. des grands lacs", the same characters being found also in the smallest ponds.

The "variété à très longues soies capillaires" is, as PIGUET himself recognizes (1909), only a form without systematical significance. MALEVICH (1927) found specimens with extremely long hairs, up to 693 μ, standing perpendicularly to the body-wall, as in *Stylaria*.

The extreme seta measurements found are: ventral setae of II—V, 69—125 μ, the rest 60—105 μ, needles 49—79 μ, hairs 115—693 μ, penial setae 89 μ. I have found: ventral setae in II, 78—117 μ, in V, 64—96 μ, needles 42—86 μ, hairs 170—570 μ.

SVETLOV (1926 a) found specimens of *N. variabilis* "imitating" *N. pardalis*, with the distal teeth of the ventral setae in II very long and curved as a 1/4 circle, those of the posterior setae 1—3 times as long as the proximal teeth, and needles half as long as the hair setae, with fairly long, parallel teeth.

Eyeless forms were reported by WOLF (1928), and ČERNOSVITOV (1938 b).

I found the genital organs to conform with PIGUET's description. The measurements found (from two specimens, the only ones found sexually fully mature) were as follows: The spermathecal ampulla is roundish, in one specimen 20—25 μ in diameter, in the other 40—50 μ. The duct is long, 45—65 μ, 15—25 μ thick, widening at the middle. There is no intrusion of the duct into the ampulla as in PIGUET's specimens. The vasa deferentia are 70—90 μ long, 8—14 μ in diameter, with walls 3—4 μ thick. They are surrounded by a dense layer of gland cells from immediately behind the funnels; the last part before the atria may lack glands. They join the atria immediately above the ejaculatory duct. The atria are roundish or pear-shaped, about 40 μ in diameter, with walls 4—7 μ thick. The duct in one specimen was very short, about 14 μ long, with a narrow lumen, as in PIGUET's figure (1909, Pl. III, fig. 10); in the other one the duct was longer, 25—30 μ, about 19 μ in diameter, being swollen at the middle, like the spermathecal duct. Thus, the conditions may vary somewhat in respect of these organs, too. — The penial setae may have a rudimentary distal tooth.

Nais simplex Piguet, 1906.

Figs. 11 *A–C*, 26 *E*; Pl. VII, figs. 3–5.

Nais variabilis var. *simplex* PIGUET, 1906, pp. 260—266, Pl. XI, figs. 22, 24, Pl. XII, figs. 1—3, 14.

Nais simplex Piguet. Piguet, 1909, pp. 202—204, Pl. III, fig. 12. Michaelsen, 1909 a, p. 19, Fig. 27. Piguet & Bretscher, 1913, pp. 34—35. Stephenson, 1922 a, p. 255; 1922 b, p. 281. Hayden, 1922, p. 167. Malevich, 1929, p. 47. Ude, 1929, pp. 50—51, Fig. 61
[?] *Nais tortuosa* Walton, 1906, pp. 698—699, Fig. 8.
[?] *Nais sp.* Stephenson, 1909 b, pp. 108—109.
[?] *Nais sp.* Stephenson. Černosvitov, 1942 b, p. 282.

Pigmentation variable. Ventral setae of II—V, 2—6 per bundle, longer, straighter and thinner than the rest, with nodulus proximal and distal tooth nearly twice the length of the proximal one; those following 2—5 per bundle, stouter, with teeth about equally long; hairs and needles 1—2 per bundle, needles simple-pointed, with nodulus more than 1/3 from the distal end. Stomachal dilatation sudden. Dorsal vessel to the left of the middle line. Nephridial funnels with a thin membrane round the border. Spermathecal ampulla small, roundish or ovoid, duct long, with a strong dilatation before the outer opening; vasa deferentia almost straight, with gland cells on their posterior half; atrial ampulla roundish, ejaculatory duct narrow; penial setae 2 per bundle. $n = 14—22$. $s = 18—37$. $l = 4—8$ mm. Swims with spiral movements.

Europe, N. America, Tibet (?).

Sweden: Waters in Småland and Närke (Almstedt, 1946); Häggsjön (S. Berg coll.); Brunnsviken, Valloxen, Metsjön, Långsjön, Siljan, Hällsjön, Yttre Sörvattnet, Lilla Gladaviken, Vallsträsket, Degerträsket.

Nais tortuosa Walton (1906) may possibly belong here. The form and size of the setae fit reasonably well, the only distinction being the shape of the stomach, a character which has cheated many.

Nais sp. Stephenson (1909 b) may belong here, too, though no adequate description could be given. The form of the setae seems to fit, though they are somewhat shorter than noticed elsewhere: ventral setae of II—V about 74 μ long, the rest about 55 μ. The suggestion by Černosvitov (1942 b) that it might be *N. barbata* seems less probable, having regard to the short setae.

The species seems as a rule to be rare. In Sweden I found it abundantly in several localities. Its appearance as a rule conforms with that reported by Piguet, resembling closely that of *N. variabilis*, from which it differs in habit only by the shortness of the hairs. In the high mountains (Idre), the specimens are somewhat larger, stouter, and less transparent than elsewhere.

The setae conform well with those described by Piguet (1906, Pl. XII, fig. 14). In II—V they are about 2 μ thick, straighter than the rest, as usual. Those of II are longer than the rest, with teeth about $\frac{7\ \mu}{4.2\ \mu}$ (Fig. 11 *A*, p. 114), then the length decreases slightly and continually backwards, and the teeth grow more and more equal in length. In the posterior segments they are about $\frac{4.5\text{–}5.5\ \mu}{4.5\text{–}5\ \mu}$, the proximal one as usual being thicker

(Fig. 11 *B*, p. 114). Below I give a table of setal lengths of a specimen from Valloxen:

	v. s. II	v. s. III	v. s. IV	v. s. V	v. s. VI	v. s. post.	n. s.	h. s.
length	93–95	83–87	83–87	85	86	73–76	66–69	190–210

The following table gives the measurements of a specimen from lake Hällsjön, showing the somewhat larger measurements of specimens from the high mountains:

	v. s. II	v. s. III	v. s. IV	v. s. V	v. s. VI	v. s. post.	n. s.	h. s.
length	102–115	86–95	86–95	87–96	86–95	77–83	69–79	240–255

The nodulus of the needle setae is always situated more than 1/3 from the tip. It is weaker than in PIGUET's figure (Fig. 11 *C*).

The extreme seta measurements found are: ventral setae in II—V, 80—110 μ, the rest 63—95 μ, needles 65—79 μ, hairs 190—262 μ, penial setae 78—95 μ. I have found: ventral setae in II, 93—105 μ, in V, 73—85 μ, the rest 63—86 μ, needles 66—76 μ, hairs 190—216 μ in the common form; in the Idre form the corresponding measurements were: 93—115 μ, 87—96 μ, 69—95 μ, 69—79 μ, and 210—255 μ respectively.

I always found the stomachal dilatation well defined.

The genital organs conform very well with PIGUET's description. The spermathecae (Fig. 26 *E*, and Pl. VII, fig. 3) have a small, roundish ampulla, when containing sperm about 30 μ × 35 μ × 35 μ, with thin walls, and a very definite duct. The latter is 40—55 μ long, with a strong dilatation immediately above the opening. Above this, the lumen is very narrow. The diameter of the duct in the narrow part is about 20 μ, in the dilatation about 30 μ. The wall thickness is 9—12 μ. (In the high mountain form the dilatation is less pronounced.) — The funnels are small, roundish, the diameter and the length being 20—25 μ, the wall thickness 5—7 μ. — The vasa deferentia are 60—90 μ long, about 15 μ thick, with walls 5—8 μ thick. Their posterior part is surrounded by scanty gland cells (Fig. 26 *E*, Pl. VII, fig. 4). — The atrial ampulla (Fig. 26 *E*, and Pl. VII, fig. 5) is roundish, 40—50 μ × 30—40 μ × 30—45 μ, with walls 3.5—6 μ thick. The ejaculatory duct is not very sharply defined, 25—40 μ long, 15—20 μ in diameter, the wall thickness being 7—9 μ.

Nais andina Černosvitov, 1939.

Nais andina ČERNOSVITOV, 1939, pp. 89—91, Figs. 26—33.

Pigment present. Ventral setae 3—4 per bundle, about equally long in all segments, distal tooth longer and thinner than proximal, more markedly so in II—V; needles 1—2 per bundle, bluntly single-pointed, with nodulus at 1/3 of the setal length from the tip; hair setae 0—2 per bundle, about 1—2 times as long as the needles, fre-

quently absent in some or all bundles. Stomachal dilatation sudden (?). $n = 29—31$. $s = 34—56$. $l =$ up to 7 mm.
S. America (Peru).

The ventral setae are stated to be 90—100 μ long in all segments, the needles 70—80 μ.

This species resembles *N. simplex*, and Černosvitov himself writes (op. cit., p. 91) "I consider it not impossible that *N. andina* will be regarded as a variety of *N. simplex*, when this species is better known." Until the sexual organs of the former are known, the question may remain open. It is very thick, 0.4—0.5 mm, like the following species. It may be a case of parallel development under similar conditions (cf. p. 116). It was found only in very cold streams, at a high altitude (over 4 000 m).

Nais alpina sp.nov.

Holotype at the Museum of Natural History, Stockholm.

Figs. 11 *D–F*, 12 *A*; Pl. VII, figs. 6, 7, Pl. VIII, figs. 1—3.

Whitish opaque, sometimes with brown pigment anteriorly. Ventral setae of II—V, 4—7 per bundle, longer, straighter and thinner than the rest, with teeth equally thick, distal tooth twice the length of the proximal, and nodulus proximal; in the following segments 3—7 per bundle, with nodulus distal, and distal tooth half as thick as proximal; needles 1—2 per bundle, obtusely simple-pointed, with nodulus 1/5—1/4 from the distal end; hairs 1—2 per bundle. Stomachal dilatation strong and sudden. Dorsal vessel to the left. Spermathecal ampulla large, oblong, hanging backwards, duct very long, narrow; vasa deferentia long, surrounded by numerous gland cells; atrial ampulla pear-shaped, atrial duct short, indefinite; penial setae 3 per bundle, single-pointed. $n = 17—19$. $s = 19—22$. l (preserved) $= 3.6—3.8$ mm. No swimming observed.
Sweden: Storån, Foskan. 35 specimens.

This species I found only in the high mountains (Idre), in very cold, rapidly running water, on sandy bottom, in contrast to *N. simplex*, which I found only in lakes. In habit it differs very much from all other species of *Nais* (except *N. andina*), being very thick, and hardly transparent.

The ventral setae of II—V (Fig. 11 *D*) resemble very much those of *N. simplex*. They are 1.7—2.5 μ thick, with teeth $\frac{7\ \mu}{3.5\ \mu} - \frac{9\ \mu}{4.5\ \mu}$. From VI on they are 2.5—3 μ thick; the distal tooth is still twice as long as the proximal one (Fig. 11 *E*); their absolute length is also the same, only diminishing slightly in the posterior segments. The following table shows the setal lengths of a specimen:

	v. s. II	v. s. III	v. s. IV	v. s. V	v. s. VI	v. s. post.	n. s.	h. s.
length	119–120	110–112	103–105	102–103	87–93	86–95	66–69	195–225
thickn.	1.7	1.8	2	2	2.6	2.8	1.5	
teeth	$\frac{7.8-8.2}{3.9-4.1}$	$\frac{7.8}{4.2}$	$\frac{7.8}{4.2}$	$\frac{7.8}{3.9}$	$\frac{6.9-7.8}{3.4}$	$\frac{7}{3.4}$		

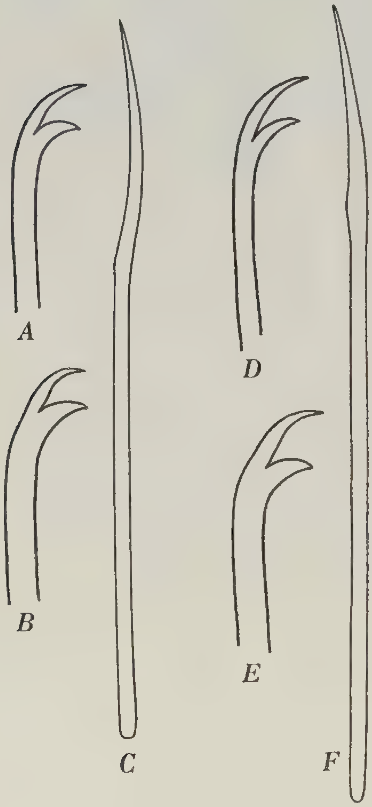

Fig. 11. *A-C Nais simplex, D-F N. alpina. A, D* distal ends of ventral setae of II, *B, F* of posterior ventral setae, *C, F* needle setae. 1500 ×.

As can be seen from the table, there is a marked fall in the length between V and VI, contrary to the state in *N. simplex.*

The needles are about 1.5 μ thick, with the nodulus at only $\frac{1}{5}-\frac{1}{4}$ of the length of the seta from the distal end. This gives them a more obtuse appearance than those of *N. simplex* (Fig. 11 *F*, cf. Fig. 11 *C*).

The extreme measurements observed were: ventral setae of II—V 102—135 μ, the rest 80—105 μ, needles 60—81 μ, hairs 195—270 μ.

The stomachal dilatation is very wide, and abrupt.

The nephridia are generally shaped like those of *N. variabilis.* I could not make out if there is a "collerette membraneuse," as in *N. simplex.*

The sexual organs are quite different from those of *N. simplex.* The spermathecae are very large. The ampulla, which hangs down backwards from the duct (Fig. 12 *A*; Pl. VII, fig. 6), is roundish, 85 μ by 50 μ by 80 μ in diameter, with fairly thick walls, about 7 μ. The duct is very long, about 120 μ, and more or less bent. The diameter is about 20 μ, the wall thickness 9 μ. Above the outer opening there is a very slight widening, giving an outer diameter of 25 μ; immediately before the opening, the wall is very thin, and the diameter only 10 μ.

The male funnels (Fig. 12 *A*; Pl. VII, fig. 7) are very strong, about 35 μ in length and diameter, with walls 12 μ thick.

The vasa deferentia (Fig. 12 *A*; Pl. VII, fig. 6) are very long, about 180 μ, their diameter being 20 μ (immediately behind the funnels 17 μ),

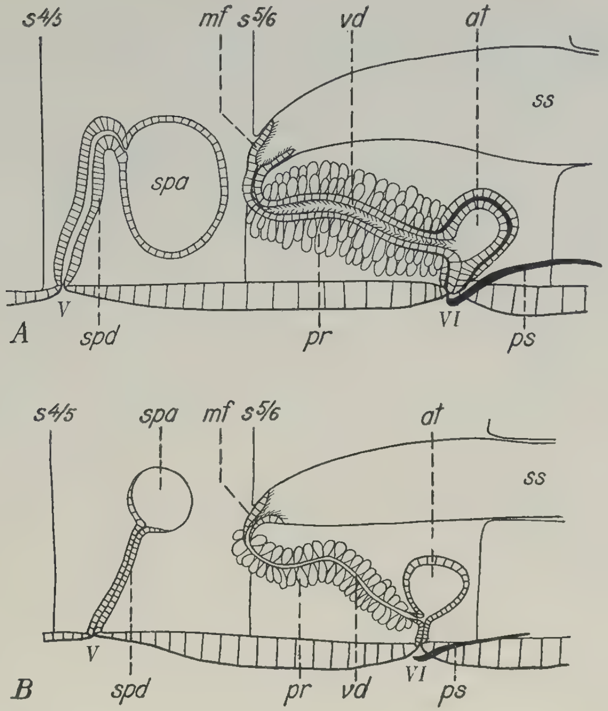

Fig. 12. Genital organs, diagrammatic. *A Nais alpina, B N. behningi,* (reconstruction after Michaelsen, 1923). (Legends p. 290). *A* 180 ×.

with walls 5 μ. Their course is the usual one: first downwards, and behind 5/6 backwards and out-wards, until they open laterally in the anterior wall of the atria, immediately above the opening of the atrial duct. Except in front of the septum, they are extremely densely beset with club-shaped gland cells, about 20 μ long, and 6—9 μ broad.

The atria (Fig. 12 *A*, Pl. VIII, figs. 1, 2) are comparatively small and pear-shaped, the ampulla being about 40 μ by 20 μ by 45—50 μ, with walls about 7 μ thick, with a strong muscular layer, and outwardly with a strong peritoneum. The atrial duct is poorly defined, 12—25 μ long.

The penial setae (Pl. VIII, fig. 3) are about 86 μ long, 4 μ thick at their widest, of the common shape, with a distal, inconspicuous nodulus, and a simple hook.

The setae of this species wholly resemble those of *Nais variabilis, E.,* "seconde forme annexe" of Piguet (1906, p. 266, Pl. XII, fig. 15). This form was also found only in small rivers (le Seyon and la Venoge), which, according to their situation ought to have rapid and fairly cold water. There was, however, no sudden decrease in length of the ventral setae between V and VI and the habit of the animals was quite different, resembling that of *N. variabilis*. This seems to exclude the otherwise possible identity of the two forms. It may be a case of partial parallel development due to similar environment (cf. also *N. andina*).

The main characters separating this species from *N. simplex* are: 1) the great difference in length between the ventral setae of II—V and the rest (in *N. simplex* only those of II are longer), and between the teeth of the posterior ventral setae (distal twice as long as proximal, against equally long in *N. simplex*); 2) the position of the nodulus in the needles ($^1/_5$—$^1/_4$ from the tip against more than 1/3); 3) the long, narrow spermathecal ducts; 4) the large, abundant gland cells along the whole vasa deferentia. — From *N. andina* it differs, as far as is known, in the first and second of the above characters, *N. andina* having all ventral setae of equal length, and the needle nodulus at 1/3 from the tip. — The simple-pointed needles and the above-mentioned characters in the sexual apparatus separate it from *N. variabilis*; the stout, obtuse needles, the long, narrow spermathecal duct, and weak atrial duct from *N. barbata* and *pseudobtusa*; the unusual body thickness from all species of *Nais*, except *N. andina*.

Nais barbata Müller, 1773.

Pl. VIII, fig. 4.

[?] *Anguille blanchâtre* Bonnet, 1779, pp. 195—200.

Die bärtige Naide Müller, 1771, pp. 80—83, Pl. III, figs. 1—3.

Nais barbata Müller, 1773, pp. 23—24.

Nais barbata Müller. Müller, 1776, p. 219. Gmelin, 1788—1793, p. 3122. Modeer 1798, pp. 138—141. Blainville, 1825, p. 131; 1828, p. 497. Ørsted, 1842, pp. 135—136, Pl. III, fig. 13. Grube, 1851, p. 104. d'Udekem, 1855, p. 551; 1859, pp. 20—21. Semper, 1877, pp. 67—73, Pl. III, figs. 9—14 [*partim*]. Tauber, 1879, p. 74. Vejdovsky, 1883, p. 218; 1884, p. 29, Pl. II, fig. 24. Timm, 1883, pp. 135—155 [*partim*]. Levinsen, 1884, p. 219 [*partim*]. Štolc, 1886, pp. 504—505. Vaillant, 1890, p. 369, Pl. XXII, figs. 14—15. Bourne, 1891, p. 344. Benham, 1892, p. 214. Beddard, 1895, pp. 283—284. Bretscher, 1896, p. 507. Ferronière, 1899, pp. 251—253 [*partim*]. Levander, 1904, p. 200.

[*non*] *Nais barbata*? Müller. Tabl. enc. méth., 1827, p. 134, Pl. LIV, figs. 2—3.

[?] *Opsonais obtusa* Gervais, 1838, p. 17.

Uronais barbata (Müller). Gervais, 1838, p. 18.

[?] *Nais Greeffi* Floericke, 1892, p. 469.

Nais obtusa (Gervais). Michaelsen, 1900, p. 25; 1903 b, p. 178; 1905 c, p. 5; 1909 a, pp. 20—21, Fig. 29. Piguet, 1906, pp. 234—237, Pl. X, figs. 2—4, Pl. XI, fig. 5, Pl. XII, fig. 8; 1909, pp. 188—193, Pl. III, figs. 2—7. Southern, 1909, p. 133, Pl. VII, fig. 2. Piguet & Bretscher, 1913, pp. 31—32. Pointner, 1914 b, pp. 99, 101. Schuster, 1915, pp. 43, 74—75. Stephenson, 1923, pp. 60—61. Svetlov, 1924, p. 195; Malevich, 1927, p. 7. Wolf, 1928, p. 394. Ude, 1929, p. 49, Fig. 59.

Yellowish brown pigment anteriorly. Ventral setae 2—5 per bundle, those of II—V much longer, thinner and straighter than the rest; with distal tooth longer than proximal and slightly thinner, nodulus proximal; those in the following segments with teeth equally long, proximal tooth much stouter, nodulus distal; needles 2—5 per bundle, single-pointed, with a long, sharp tip, and only slightly distal nodulus; hairs 1—5 per bundle, stiff. Stomachal dilatation sudden. Dorsal vessel to the left. Spermathecal ampulla elongated, when filled stretching back through the whole of VI, duct long, well marked off, forcibly dilated; vasa deferentia long, sinuous, covered with gland cells; atrial ampulla roundish, when filled elongated back-wards, walls muscular, thickened round the opening of the vas deferens; ejaculatory duct distinct, narrow; penial setae 2—3 on each side, with a simple hook. $n = 11$—19. $s = 25$—33. $l = 3.5$—6 mm. Swims with spiral movements.

Europe, Asia, N. America.

Sweden: Waters in Scania and Småland (ALMSTEDT, 1946); Ullevifjärden (M. WÆRN coll.); Lövsjön (S. BERG coll.); Ekoln, Siljan, Lilla Gladaviken, Kyrksjön, Vallsträsket, Degerträsket.

There is no doubt that this species is identical with "die bärtige Naide" of O. F. MÜLLER. The figure (MÜLLER, 1771, Pl. III) is quite typical, with the numerous, stiff, slightly curved hairs, and the long ventral setae of II—V, giving the appearance of a "beard." Most later authors were also able to identify it; BEDDARD, however (1895, p. 283), considered the identification doubtful, and would have changed the name *barbata* for *obtusa* (Gervais), had not the former been so long in use. MICHAELSEN later (1900) changed it, and all other authors have followed him. — The identification of *Opsonais obtusa* is in fact, however, extremely doubtful. GERVAIS (1838) gives only the following characters: "elle est remarquable par ses extrémités céphalique et anale obtuses, au lieu d'être effilés comme chez la précédente; ses soies sont courtes, ses points oculaires noirs et la couleur de son corps blanchâtre." This description seems to fit in rather with e. g. *Piguetiella blanci*, than with the present species. The identification seems to be due to D'UDEKEM (1855). — BLAINVILLE, and after him GERVAIS, had the curious conception that *N. barbata* had gills, and placed it together with *N. digitata*.

Earlier authors were often not able to distinguish the present species from "*N. elinguis*," and SEMPER (1877), TIMM (1883), and DIEFFENBACH (1885, p. 104) especially confused them.

MICHAELSEN (1900) placed here, with a question-mark, *N. Greeffi* Floericke, probably correctly. It has dorsally "zweierlei durchaus haarförmige Borsten," but ventral setae all "ziemlich gleichlang" in contrast to the (very exaggerated) statement by VEJDOVSKY (1884) that those of II—V are twice as long as the rest.

I have not much to add to Piguet's description. Pl. VIII, fig. 4 shows the habit of a simple individual. Below are some seta measurements from a specimen from lake Siljan:

	v. s. II	v. s. V	v. s. VI	v. s. post.	n. s.	h. s.
length	119–128	113	96–105	81–90	104–116	270–288
thickn.	2.7	3	4.5	3.3	3	3
teeth	$\frac{7.7}{4.8}$	$\frac{7.5}{6}$	$\frac{6.7}{7.5}$	$\frac{6.7}{6.7}$		

As is shown, the ventral setae of VI are very stout, with the distal tooth shorter than the proximal one, but posteriorly both length and thickness of the setae diminish considerably, and the teeth become equally long.

The extreme seta measurements found are: ventral setae in II—V, 96—138 µ, the rest 75—113 µ, needles 89—132 µ, hairs 135—311 µ. I found ventral setae in II—V, 96—132 µ, in the rest 75—113 µ, needles 90—132 µ, hairs 135—288 µ.

The species is common and abundant in Sweden.

Nais pseudobtusa Piguet, 1906.

Nais barbata Müller. Ferronière, 1899, pp. 251—253 [*partim*].
Nais obtusa (Gervais) var. *pseudobtusa* Piguet, 1906, pp. 238—241, Pl. X, figs. 5—7, Pl. XI, figs. 4, 6, 7, Pl. XII, fig. 9.
Nais pseudobtusa Piguet. Piguet, 1909, pp. 193—195, Pl. III, fig. 8. Piguet & Bretscher, 1913, pp. 33—34. Malevich, 1927, p. 8.
Nais pseudoobtusa Piguet. Michaelsen, 1909 a, p. 20, Fig. 28. Pointner, 1914 b, pp. 98—99. Hayden, 1922, p. 167. Svetlov, 1924, pp. 194—195. Wolf, 1928, pp. 395, 406. Ude, 1929, p. 50, Fig. 60. Szarski, 1936 b, p. 397, Pl. XVIII, fig. 10.
Nais pseudoobtusa (Piguet), var.? Michaelsen, 1914, pp. 151—152.
[?] *Pristina variabilis* Friend, 1916, p. 25.
[?] *Nais incerta* Černosvitov, 1942 b, p. 252.

Brown pigment often present. Ventral setae of II—V, 2—5 per bundle, longer, straighter and slenderer than the rest, with distal tooth 1 1/2 as long as proximal and with proximal nodulus, the rest 2—6 per bundle, with distal nodulus, stouter than the former, and with proximal tooth thicker; hairs and needles 1—3 per bundle, needles with long, pointed tip, and nodulus 1/3 from the tip. Stomachal dilatation sudden. Dorsal vessel to the left. Spermathecal ampulla ovoid, duct long, dilated. Male funnels very thick, with a median, ciliated lobe; vasa deferentia relatively short, thick, and straight, covered with glands from funnel to atrium; atrial ampulla globular, wall not thickened, duct well defined, narrow; penial setae 2—3, often with a vestigial distal tooth. $n = 11—18$. $s = 17—28$. $l = 1.7—6$ mm. Swims with spiral movements.

Europe, N. America, Africa.

Sweden: Småland: Lake Fiolen (Almstedt, 1946); Landösjön (S. Berg coll.); Trehörningen, Hällsjön, Yttre Sörvattnet, Lilla Gladaviken.

There seems to be no reason to assume MICHAELSEN's *N. pseudoobtusa*, var.? to have any systematic value, as the only difference was the length of the hair setae, hardly as long as the body diameter. As pointed out below, the lengths of the hair setae vary very considerably.

Pristina variabilis Friend (renamed by ČERNOSVITOV *Nais incerta*), may belong here, though the description is insufficient.

Several authors find it difficult to separate this species from *N. barbata*, and POINTNER (1914 b) is inclined to regard it as only a variety of the latter. This is, however, impossible, as the two species frequently live together without any occurrence of intermediates. In fact, the number, and relative and absolute lengths of the setae transgress considerably (as pointed out by SVETLOV, 1924), but two characters always seem to hold: 1) the shape of the ventral setae from VI backwards, which are in *N. barbata* much thicker than the preceding ones (4.5 μ and 3 μ respectively), with teeth about equally long, while in *N. pseudobtusa* both kinds are thin, about 1.7 μ and 1.3 μ resp., with the distal tooth about 1 $^1/_2$ as long as the proximal one; 2) the shape of the needles, with the nodulus in *N. barbata* almost median, in *N. pseudobtusa* at $^1/_3$ of the setal length from the tip. — The following table gives measurements from one specimen from Lake Y. Sörvattnet:

	v. s. II	v. s. V	v. s. VI	v. s. post.	n. s.	h. s.
length	80–93	70–71	55–71	57–59	57–59	163–245
thickn.	1.2	1.3	1.7	1.6	1.2	1.2
teeth	$\frac{6}{3.7}$	$\frac{5.2}{3.4}$	$\frac{5.2\text{–}6.2}{3.4\text{–}4.3}$	$\frac{4.5\text{–}5.2}{3\text{–}3.5}$		

The extreme seta measurements found are: ventral setae in II—V 78—115 μ, the rest 54—95 μ, needles 57—104 μ, hairs 163—370 μ. I found: ventral setae in II—V, 71—99 μ, the rest 54—71 μ, needles 57—75 μ, hair setae 163—300 μ.

I have never found sexually mature specimens of this species.

The species is much less common in Sweden than *N. barbata*.

Nais behningi Michaelsen, 1923.

Fig. 12 *B*.

Nais behningi MICHAELSEN, 1923, pp. 34—37, Fig.
Nais behningi Michaelsen. SVETLOV, 1924, p. 194. BEHNING, 1929, p. 250. HRABĚ, 1941, pp. 19—20, Figs. 1—7.

Ventral setae of II—V, 6—10 per bundle, longer, straighter, and half as thick as the rest, distal tooth enormously long, strongly curved, proximal tooth reduced or vestigial; those following 2—5 per bundle, with nodulus slightly proximal, and distal tooth twice as long as, and thinner than proximal; hairs and needles 1—2 per bundle, needles with thin, simple-pointed distal end. Stomachal dilatation sudden. Spermathecal ampulla small, globular, thin-walled, duct twice as long as ampulla, well-defined, narrow, with thick walls; vasa deferentia moderately long, strongly curved, but not winding, in their whole course surrounded by gland cells and joining atria immediately above the atrial duct; atria roundish or pear-shaped, with a thin muscular layer, duct short, narrow; penial setae 2—4 per bundle, with a simple hook. Swimming?

East and Central Europe.

The setae are stated to be about 120 μ long, ventrally in II—V, 80—90 μ in the rest, the needles 56—84 μ long, 1 μ thick, the hairs 180—308 μ long, 1—1.5 μ thick.

I have tried to reconstruct the sexual organs after MICHAELSEN's description (Fig. 12 *B*, p. 115). As M. points out, the species most resembles *N. pseudobtusa* in respect of the setae; the genital organs show the same affinity, though there are, of course, also differences. M. assumes the numerous hooked ventral setae in the anterior segments to be adjusted for anchoring in loose bottoms.

Nais bretscheri Michaelsen, 1899.

Fig. 13 *A–M*.

Nais bretscheri MICHAELSEN, 1899, pp. 121—122.

Nais Bretscheri Michaelsen. BRETSCHER, 1899, pp. 389—390, Fig. 1. PIGUET, 1906, pp. 267—270, Pl. X, fig. 19, Pl. XII, figs. 6, 16; 1909, pp. 205—206, Pl. III, fig. 13. PIGUET & BRETSCHER, 1913, pp. 29—30.

Nais bretscheri Michaelsen. MICHAELSEN, 1900, p. 26; 1909 a, p. 17, Fig. 22; 1923, p. 31. SVETLOV, 1924, p. 193. WOLF, 1928, pp. 393—394, 401. UDE, 1929, pp. 43—44, Fig. 53. ČERNOSVITOV, 1930, p. 10.

[*? non*] *Nais bretscheri* Michaelsen. MICHAELSEN & BOLDT, 1932, p. 591. CHEN, 1940, p. 35, Fig. 5.

Eyes sometimes absent. Anterior end often heavily pigmented. Ventral setae of II—V, 2—7 per bundle, thin and straight, with distal tooth about double the length of proximal; those of the following segments 1—6 per bundle, three types being distinguishable: 1) normal setae with distal nodulus of 3 sorts of different thickness, with distal tooth 1—3 times as long as proximal, but thinner; 2) thick setae, longer and thicker than the former, with distal tooth as thick as, and 2—3 times as long as proximal; 3) in some cases giant setae, very long and thick with distal tooth abruptly bent at the base, and reduced proximal tooth; giant setae always alone, thick setae 1—2 per bundle, often together with 1—2 normal setae; hairs and needles 1—2 per bundle; needles double-pronged, with nodulus 1/3 from the distal end; hairs short. Stomachal dilatation slow. Dorsal vessel to the left. Spermathecal duct not dilated; vasa deferentia with prostate gland cells; atria globular; penial setae 2 per bundle, of the common *Nais* shape. $n = 13—22$. $s = 19—34$, $l = 3—7$ mm. Swimming never observed.

Europe, Turkestan.

Sweden: Ekoln.

This species is extremely variable with respect to its ventral setae. In II—V they are always very thin, 1.6 μ, with a very long, curved distal tooth (Fig. 13 *A*; cf. Piguet, 1906, Pl. XII, fig. 16 b). From VI on there are partly normal setae, partly enlarged ones, with the proximal tooth reduced to a varying extent. Piguet (1906) is the first to give a detailed account of them. He found one type of ordinary setae (op. cit., Pl. XII, fig. 16 c), and two types of thick setae: "grosses soies," and "très grosses soies" (op. cit., Pl. XII, fig. 16 d). The latter he found, when present, in XIII, IX—XIII, or X—XIII, the former in one or more of VII—XIII, posteriorly often passing gradually into normal setae. Svetlov (1924) found giant setae (= "très grosses soies") in VII—XIII, and transitions into normal setae. He found no enlarged setae in the posterior zooids, and states that they must develop after separation. Piguet saw the first traces of thick setae in XII and XIII in advanced zooids. — As to *N. bretscheri* Michaelsen Michaelsen & Boldt (1932) and Chen (1940) see p. 126.

I have made a careful examination of the setae of specimens found in Ekoln. There was only one specimen with giant setae. They were present in VIII—XI, and had the typical shape figured by Piguet, with only traces of the proximal tooth (Fig. 13 *H*—*L*), and the distal one 12—15 μ long. In VII, and XIII—XIX there were thick setae, 4.5 μ, with a small proximal tooth, and the distal one more curved, in a less acute angle to the shaft (Fig. 13 *G*). In XII a transition between the two types, 6.7 μ thick, was present (Fig. 13 *M*), and in VI, and XX—XXII 3.7 μ thick setae, with the distal prong in VI 3 times the length of the proximal one (Fig. 13 *F*). See the following table:

	v. s. VI	v. s. VII	v. s. VIII	v. s. IX	v. s. X	v. s. XI	v. s. XII	v. s. XIII	v. s. XV	v. s. XX
number	3	2	1	1	1	1	1	2-3	3	3
length	91	101	112	112	120	120	107	89	89	86
thickn.	3.7	4.5	7.5	7.5	7.5	7.5	6.7	4.5	4.5	3.7
teeth	$\frac{9}{3}$	$\frac{11}{1.5}$	$\frac{14}{\text{rud.}}$	$\frac{15}{0}$	$\frac{15}{\text{rud.}}$	$\frac{12}{\text{rud.}}$	$\frac{12}{\text{rud.}}$	$\frac{9\text{–}10}{1.5}$	$\frac{7.5}{2}$	$\frac{6.7}{3}$

In specimens without giant setae, the conditions were complicated. In one specimen there were in VI two normal setae, 3.2 μ and 3.5 μ thick, in VII—XIII one normal seta, 3.5 μ thick, and one thick seta, 4.5 μ thick, or slightly thinner posteriorly, with distal tooth almost three times longer than proximal in the anterior segments, less posteriorly (Fig. 13 *E*); in XIV these two types + another, thinner, 3.1 μ thick; in XV no thick seta, but the two normal types of XIV and one thinner still, 3 μ thick (Fig. 13 *B*—

D). The teeth of the 3.5 μ thick setae gradually grow more equal in size posteriorly, as usual, from $\frac{9.6\ \mu}{3.7\ \mu}$ to $\frac{7.2\ \mu}{4.8\ \mu}$; the teeth of the two thinner sorts are equally long. In the second zooid only these three normal sorts are found, and in the third zooid only the thinnest sort. The following table gives the conditions in the first zooid:

segment	number	setal length				setal thickness				teeth			
		a	*b*	*c*	*d*	*a*	*b*	*c*	*d*	*a*	*b*	*c*	*d*
VI	2		75	83			3.2	3.5			$\frac{9.6}{3.7}$	$\frac{9.6}{3.7}$	
VII	2			83	86			3.5	4.2			$\frac{8}{4.8}$	$\frac{9.6}{3.7}$
VIII	2			82	85			3.5	4.5			$\frac{7.2}{4.8}$	$\frac{9.6}{3.5}$
IX–X	2			83	86			3.5	4.5			$\frac{6.7}{4.8}$	$\frac{9.3}{3.5}$
XI	2			83	83			3.5	4.5			$\frac{6.4}{4.8}$	$\frac{9.3}{3.5}$
XII	2			82	80			3.4	4.3			$\frac{6.4}{4.8}$	$\frac{9.3}{4}$
XIII	2			78	78			3.4	4			$\frac{6.4}{4.8}$	$\frac{9.3}{4.5}$
XIV	3		78	78	+		3.1	3.4	4		$\frac{5.3}{5.3}$	$\frac{7.2}{4.8}$	$\frac{9.3}{4.5}$
XV	3	77	77	82		3	3.2	3.5		$\frac{5.3}{5.3}$	$\frac{5.3}{5.3}$	$\frac{7.2}{4.8}$	

+ This seta was incomplete.

The setal types are designed *a, b, c, d,* from thinner to thicker.

In other specimens the thick setae were found as far back as in XVIII. The following table gives the conditions in the second zooid of another chain (*n* of this zooid = 14):

	v. s. II	v. s. III	v. s. IV	v. s. V	v. s. VI		v. s. VII		v. s. XIV	
					a	*c*	*a*	*c*	*a*	*c*
length	83	78	78	75		73	73	75	70	71
thickn.	1.6	1.6	1.6	1.6	3	3.5	3	3.5	3	3.5
teeth	$\frac{7.5}{3.7}$	$\frac{6.7}{3.3}$	$\frac{6.7}{3.3}$	$\frac{6.7}{3.3}$	$\frac{7.4}{6}$	$\frac{5.7}{6}$	$\frac{7.4}{6}$	$\frac{5.7}{6}$	$\frac{7.4}{6}$	$\frac{5.7}{6}$

Here, only two setae per bundle, of the types *a* and *c*, are present; in some of the other segments, type *b* was also found. — Thus, it seems, that at

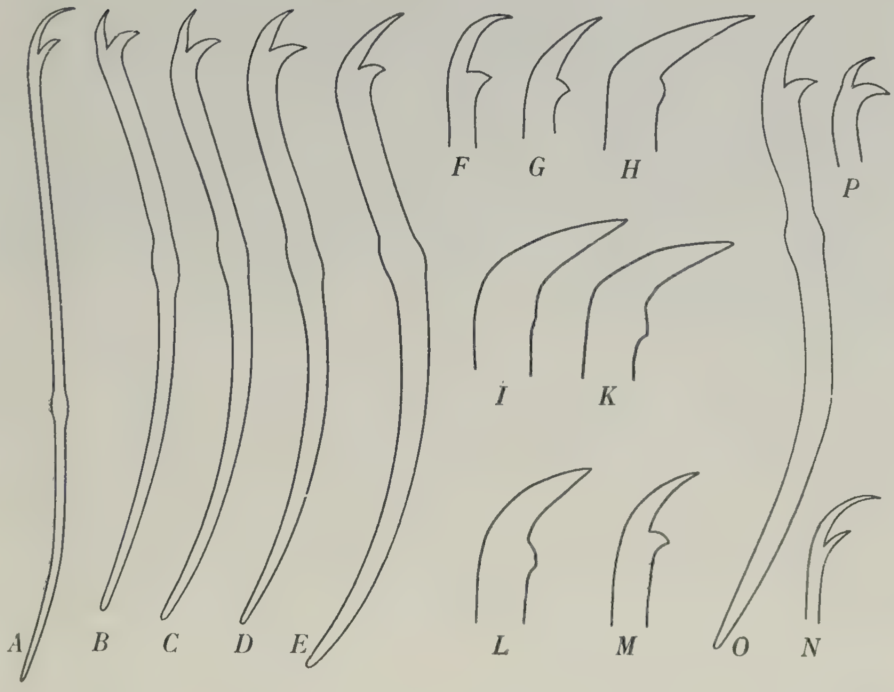

Fig. 13. *A—M Nais bretscheri.* Ventral setae, *A* from II, *B-D* normal setae from XV, *E* thick seta from VIII of a specimen without giant setae, *F* distal end of thick seta from VI, *G* from VII, *M* from XIII of a specimen with giant setae, *H-L* giant setae from VIII–XI of the same. *N-P Nais pardalis. N* distal end of ventral seta from II, *O* thick seta from VI, *P* ventral seta from XVIII. 1000 ×.

first only setae of the thinnest sort are formed, then types *b* and *c*, then the thick setae, type *d*, about the time of the separation of the bud, and, at last, possibly not always, the giant setae. Types *a*, *b*, and *c* begin in VI, the enlarged setae in VII, (or the giant setae farther back) the process proceeding backwards, ever thicker setae replacing the thinner ones. At those points, where the replacing process is actually at work, transitional types between giant setae and thick setae, and between the latter and the thickest normal setae may be found. — The reasons for the process seem obscure.

The extreme seta measurements found are: ventral setae of II—V 75—105 μ, normal setae of hinder segments 70—88 μ, thick setae 78—101 μ, giant setae 112—125 μ, needles 52—68 μ, hairs 84—106 μ. In my material the corresponding lengths were: 75—100 μ, 65—83 μ, 78—86, 112—120 μ, about 73 μ, and about 135 μ respectively.

None of my specimens were mature. I found $n = 16$—22, $s = 26$.

Nais pardalis Piguet, 1906.

Fig. 13 *N–P*; Pl. VIII, figs 5, 6.

Nais Bretscheri Michaelsen var. *pardalis* PIGUET, 1906, pp. 270—274, Pl. X, fig. 20, Pl. XII, figs. 4, 5, 17.

Nais pardalis Piguet. PIGUET, 1909, pp. 206—209, Pl. III, figs. 14—16. MICHAELSEN, 1909 a, pp. 17—18, Fig. 23. PIGUET & BRETSCHER 1913, pp. 30—31. SCHUSTER, 1915, pp. 40, 71. SVETLOV, 1924, p. 193. PIGUET, 1928, p. 81. WOLF, 1928, pp. 395, 401. UDE, 1929, pp. 48—49, Fig. 58. SZARSKI 1936 b, p. 397. MARCUS, 1943, pp. 31—32, Pl. III, figs. 15—16, Pl. IV, figs. 17—18.

[?] *Nais bretscheri* Michaelsen. MICHAELSEN & BOLDT, 1932, p. 591. CHEN, 1940, p. 35, Fig. 5.

Brown pigment anteriorly. Ventral setae of II—V, 2—5 per bundle, with distal tooth 1 1/2 –2 times as long as proximal, and nodulus median or slightly proximal; from VI on 1—5 per bundle, with distal nodulus, of two sorts: 1) normal setae of three kinds, with teeth equal, or distal tooth slightly longer or shorter than proximal; 2) usually thick setae, with distal tooth 2—3 times as long as proximal; needles 1—2 per bundle, with nodulus about 1/3 from the tip, and two fine, equal teeth; hairs 1—2 per bundle. Stomachal dilatation sudden, elongated cells projecting into the lumen. Dorsal vessel to the left. Spermathecal ampulla ovoid, duct well defined, with a distal swelling; vasa deferentia surrounded by gland cells in front of the atria; atrial ampulla pear-shaped, thick-walled, duct poorly defined, narrow, curving forwards; penial setae 3 per bundle, of the common type. $n = 13—21$. $s = 19—32$. $l = 2.5—7$ mm. Swimming with spiral movements.

Europe, Asia(?), S. America.

Sweden: Fyrisån, Skedviken, Lilla Gladaviken.

PIGUET (1906) states: "A partir du 6e segment les crochets ventraux sont très semblables aux soies posterieures de *N. Bretscheri.*" This is very typical, for quite as in *N. bretscheri*, there are, in fact, three types of "normal" setae, resembling each other, but each thinner than the following, the two thinnest sorts having about equally long teeth, the thickest slightly longer distal tooth. The thickness increases from about 2.4 μ to 3.2 μ; thus, they are thinner than in *N. bretscheri*. Besides these, there are also thick setae, with the distal tooth about 3 times as long as the proximal, and equally thick, but these setae are considerably thinner, too, than the corresponding setae of *N. bretscheri*, about 3.7 μ, and thus do not appear so strikingly different from normal setae — in fact, these are the ones figured by PIGUET (1906, Pl. XII, fig. 17 c). These setae are present in a varying number of anterior segments; from VI onwards I found them as far back as XVIII; they may also be lacking entirely or only in a segment here and there. Normal setae are often present in the same bundles. — The teeth of the needles were shorter than in PIGUET's figure, about as long as in *N. variabilis*. The following table gives the conditions in a specimen from Lake Lilla Gladaviken:

a) Ventral setae of II–V, and dorsal setae.

	v. s. II	v. s. III	v. s. IV	v. s. V	n. s.	h. s.
length	98–99	96	98	90–91	64–66	110–120
thickn.	1.9	2.4	2.4	2.4	2.4	
teeth	$\frac{7.7\text{–}8}{3.5\text{–}4}$	$\frac{8}{4}$	$\frac{8}{4}$	$\frac{8}{4}$	$\frac{1.3}{1.3}$	

b) Ventral setae from VI onwards.

segment	number	setal length				setal thickness				teeth			
		a	*b*	*c*	*d*	*a*	*b*	*c*	*d*	*a*	*b*	*c*	*d*
VI	3				82				3.5				$\frac{8}{2.5}$
VII	2	69				2				$\frac{5}{4.8}$			
VIII	2				85				3.7				$\frac{8.3}{2.5}$
IX–X	1–2				85				3.7				$\frac{8.3}{2.5}$
XI–XIV	2			80	80–83			3.2	3.7			$\frac{7}{3}$	$\frac{8.3}{2.5}$–$\frac{8}{3}$
XV–XVI	2			82	82			3	3.7			$\frac{6.4}{4.5}$	$\frac{7.7}{4}$–$\frac{8}{4}$
XVII	3	71		80	82	2.4		3	3.7	$\frac{4}{4}$		$\frac{6.4}{4}$	$\frac{8}{4}$
XVIII	2		75	78			2.7	3.1			$\frac{4.8}{4}$	$\frac{6.4}{4}$	
XIX–XX	3	72	75	75		2.4	2.7	3.1		$\frac{4.8}{4.8}$	$\frac{4.8}{4}$	$\frac{6.4}{4}$	
XXI–XXII	4	72	72	72		2.4	2.7	3.3		$\frac{4.8}{4.8}$	$\frac{4.8}{4.8}$	$\frac{5.6}{4.8}$	

SVETLOV (1924) gives unusually large measurements: ventral setae in II—V 126—135 μ, the rest 99—108 μ, needles 72 μ, hairs 279—297 μ. — Otherwise the extreme seta measurements found are: ventral setae of II—V 90—110 μ, from VI on, normal setae 64—82 μ, thick setae 80—93 μ, needles 60—72 μ, hairs 95—215 μ. I found ventral setae in II, 98—108 μ, in V, 90—99 μ, in the rest normal setae, 66—78 μ, and thick setae, 80—93 μ, needles 60—82, hairs 90—215.

PIGUET did not observe swimming in the species, but my specimens swam in the ordinary *Nais* manner.

The specimens from lake Skedviken (19 sp.) deviate from the above in certain respects. The ventral setae of II—V are 78—108 μ long, and 1.5—1.8 μ thick. The posterior setae are thicker, the normal ones being 3—4 μ thick; here the distal tooth is not longer than the proximal, in the two thinner sorts even shorter (Fig. 13 *P*, p. 123). The thick setae, 86—90 μ long, are characteristically thickened just below the base of the teeth (Fig. 13 *O*), 4.8 μ at the thickest place. The thick setae are found from VI backwards as far as XX, or in a couple of segments only. Posteriorly transitional types to normal setae of the thickest sort are frequently found. The following table gives an example of the setal conditions:

segment	number	setal length				setal thickness				teeth			
		a	*b*	*c*	*d*	*a*	*b*	*c*	*d*	*a*	*b*	*c*	*d*
VI	4	69	69	64	+	2.9	3.2	4	4.8	$\frac{4.5}{5.5}$	$\frac{4.8}{5.5}$	$\frac{5.5}{5.5}$	$\frac{9}{3.5}$
VII	3		72	70	+		3.2	4	4.8		$\frac{4.8}{5.5}$	$\frac{5.5}{5.2}$	$\frac{9}{3.5}$
VIII	4	74	72	69	+	3	3.4	4	4.5	$\frac{4.8}{5.5}$	$\frac{5.1}{5.5}$	$\frac{5.5}{5.5}$	$\frac{9}{3.5}$
XXIV	3	72	72	70		2.9	3.4	4		$\frac{4.8}{5.5}$	$\frac{5.1}{5.5}$	$\frac{5.5}{5.5}$	

The needles were 2 μ thick, with teeth $\frac{2\,\mu}{2\,\mu}$.

Thus, in *N. pardalis* apparently the same process as in *N. bretscheri*, of replacing setae for thicker ones, is at work.

It seems that *N. bretscheri* Michaelsen of MICHAELSEN & BOLDT and CHEN, may be something resembling my form of *N. pardalis* from Skedviken, rather than *N. bretscheri*. BOLDT states: "Die Rückbildung der unteren Zinke findet sich bei den vorliegenden Stücken bereits in den ventralen Borsten vom 6. bis zum 11. Segment einschliesslich; extrem vergrösserte Borsten sind in diesen Segmenten nicht festgestellt." — CHEN gives measurements: ventral setae in II—V 80—95 μ long, 1.4—2.0 μ thick, from VI on very stout, 80—88 μ long, 4.0—4.2 μ thick; needles 60—72 μ long, 2—2.5 μ thick, hairs 120 -160 μ long. Thus, in both these forms the enlarged ventral setae begin already in VI, as in *N. pardalis*, and no giant setae are found; the measurements given by CHEN fit in very well, only the teeth of the needles seem to be longer than is usual in either species. His picture of a ventral seta from VI is also reminiscent of the thick setae of *N. pardalis* from Skedviken (Fig. 13 *O*).

As to the peculiarities of the stomach see p. 23.

I never met with sexually mature individuals of *N. pardalis*.

Nais elinguis Müller, 1773.

Fig. 14 *A–C*; Pl. IX, figs. 1—3.

[?] *Die zungenlose Naide* Müller, 1771, pp. 74—79, Pl. II [? *partim*].
[?] *Nais elinguis* Müller, 1773, p. 22 [? *partim*].
[?] *Nais elinguis* Müller [? *partim*]. Several authors (see *N. communis*). Michaelsen, 1905 b, p. 306.
[?] *Opsonais elinguis* (Müller). Gervais, 1838 p. 17 [? *partim*].
Nais elinguis Müller. Ørsted, 1842, p. 135 [*partim*]. Michaelsen, 1900, p. 25 [*partim*]; 1903 b, pp. 175—178, Pl., fig. 4; 1909 a, p. 18, Fig. 24; 1926 a, p. 21; 1927 a, p. 10, Fig. 5. Piguet, 1906, pp. 241—247, Pl. X, fig. 8, Pl. XI, figs. 8—13, Pl. XII, fig. 10. Pierantoni, 1911, pp. 2—3, Pl. IV, figs. 13—16. Piguet & Bretscher, 1913, pp. 36—37. Schuster, 1915, pp. 40—41, 71—73. Smith, 1918, p. 639. Stolte, 1921, pp. 547—549. Stephenson, 1922 b, pp. 279—280; 1923, pp. 58—59. de Vos, 1922, pp. 276—277. Mehra, 1924, pp. 179—182, Fig. 5, Pl. IV, figs. 11, 13, Pl. V, fig. 23; 1925, pp. 412—413, Pl. XXXV, fig. 3. Wolf, 1928, pp. 394, 405—406. Ude, 1929, pp. 45—46, Figs. 54, 55. Černosvitov, 1930, p. 10; 1937 a, pp. 70—71; 1939, pp. 91—92, Figs. 34—42. Redeke & de Vos, 1932, p. 16. Knöllner, 1935, pp. 434—435, Fig. 1. Kondô, 1936, p. 384, Pl. XXIII, fig. 11. Hrabě, 1936, p. 1270, Fig. 11; 1937 b, pp. 4—6, Fig. 1. Szarski, 1936 b, p. 396.
Nais aralensis Lastočkin, 1922, p. 279.

Eyes usually present. Anterior end usually pigmented reddish brown. Ventral setae 2—5 per bundle, those of II—V hardly longer, slightly straighter and thinner than (or less than half as thick as) the rest, with nodulus 1/3—1/2 from the distal end, and with distal tooth about twice as long as proximal; from VI on with nodulus distal, and distal tooth twice as long and 1/2—1/1 as thick as proximal; hairs and needles 1—3 per bundle, needles with nodulus 1/4—1/3 from the tip, and teeth long, distal tooth longer than proximal. Stomachal dilatation slow. Dorsal vessel mid-dorsal. Spermathecal ampulla large, elongated, duct long, narrow; vasa deferentia long, curved, wholly surrounded by abundant gland cells, joining atria immediately above atrial duct; atrial ampulla globular, extremely strongly muscular, duct long, well defined, wide; penial setae 4—5 per bundle, with a simple distal hook. $n = 12—21$. $s = 15—37$. $l = 2.2—12$ mm. Swims with lateral movements.

Cosmopolitan. Frequently in brackish water (the Baltic, the North Sea, the Firth of Clyde).

Sweden: The Baltic at Utö (G. Jägersten coll.); Hårsfjärden (S. Bock coll.; Jonhammar coll.); Gällnarfjärden, Vettersö-Växlet, the harbour of Bönan (S. Bock coll.); Sävsundet (I. Arwidsson coll.); Avasundet, Kråkångersfjärden, the harbour of Bjurö.

As has been stressed before (pp. 103, 108), several species were earlier included under the name *Nais elinguis*, certainly also the present. The *N. elinguis* of O. F. Müller was possibly *N. communis* (see this species), but Michaelsen, who was the first to describe the sexual organs thoroughly, and thus to allow of a sure identification, chanced to have the present species before him. — *Nais aralensis* Lastočkin belongs here (cf. Hrabě, 1936). Lastočkin's specimens had no eyes.

The conditions within the species seem not yet to have been made quite clear, for most authors, who have mentioned the matter (Michaelsen, Piguet, Stephenson, Knöllner, Hrabě), agree that the ventral setae all have the distal tooth 2—3 times as long as the proximal, the setae of II—V being almost equal to the rest, only very slightly thinner and longer, and the teeth of the needles subequal. Černosvitov (1939), however, points out that all his specimens from places as far from each other as Ural, Turkestan, and Titicaca, have the setae of II—V at most half as thick as the rest, and in the hind body the distal tooth of the latter is equal in length to the proximal. The distal prong of the needles is stated to be markedly longer than the proximal. He is of the opinion that Knöllner's specimens which show the normal characters represent a new species. As yet it is impossible to judge whether there are in reality one or two species, but if there are two, the new one will be that represented by Černosvitov's finds.

My specimens agree well with the common conception. The setae of II—V are straighter than those following, on an average slightly longer, 78—96 μ against 72—93 μ, also somewhat thinner, 1.5—1.9 μ against 2.2—2.4 μ, with the nodulus median, or usually somewhat distal, while in the others it is more pronouncedly distal, though not so much so as in other species of *Nais*. Both kinds have the distal tooth about twice as long as the proximal and about half as thick (Fig. 14 *A*, *B*; cf. Piguet, 1906. Pl. XII, fig. 10; in Michaelsen's specimens they were equally thick). The needles are 58—87 μ long, the hairs 200—285 μ. The distal tooth of the needles is usually slightly longer than the proximal, but the difference may be imperceptible (Fig. 14 *C*). The length of the teeth varies from about $\frac{3.4\ \mu}{3.1\ \mu}$ to $\frac{4.6\ \mu}{4.3\ \mu}$. As Hrabě points out (1936, Fig. 11; 1937 b, Fig. 1; see also Knöllner, 1935, Fig. 1) the teeth are fairly stout, straight and parallel, not fine and diverging, as in Piguet's figure. Below is a table with measurements:

	v. s. II	v. s. III	v. s. IV	v. s. V	v. s. VI	v. s. post.	n. s.	h. s.
number	2	2	2	2	3	2–3	2–3	1–2
length	78–80	78	72–77	77	72–77	72–80	58–77	200–227
thickn.	1.9	1.7	1.7	1.5	2.4	2.4	1.5	

The extremes found are: ventral setae of II—V 72—112 μ, the rest 72—105 μ, needles 58—99 μ, hairs 150—305 μ; penial setae up to 121 μ long, 4 μ thick.

As to the sexual organs, this species differs from the others in having the atria extremely muscular (Pl. IX, figs. 1, 2; cf. Piguet, 1906, Pl. XI, fig. 8; Mehra, 1925, Pl. XXXV, fig. 3), with the duct about 1 $^1/_2$ times as long as the ampulla.

As some of the specimens which were collected and kindly brought to me alive by Professor G. Jägersten, were sexually mature, I give some measurements below (from two sectioned specimens). The spermathecae are confined to V, where they largely fill the available space. The ampullae (Pl. IX, fig. 3) are large, bag-like, somewhat twisted round each other, the length being about 225—240 μ, the largest diameter 90—105 μ; they have a thin epithelium and a conspicuous muscle layer, 1.5—3 μ thick. The duct is fairly long, about 75 μ, with an outer diameter of 24—28 μ, and an inconspicuous lumen. The epithelium is columnar, and the muscle layer conspicuous.

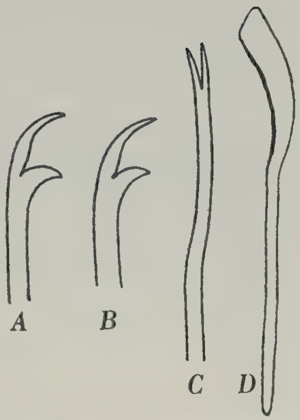

Fig. 14. *A-C Nais elinguis.* Distal ends of setae, *A* from II, *B* from a posterior segment, *C* needle seta. *D Nais schubarti.* Needle seta (from Marcus, 1944). *A-C* 1500 ×, *D* 850 ×.

The male funnels are fairly symmetrical, about 45 μ long, and 45 μ wide. — The vasa deferentia are long and winding; their length is difficult to measure, but seems to be about 250—400 μ. They join the atria at their lower face. Nearest to the atria they are about 15 μ wide, with the muscle layer of the atria running out to them (Pl. IX, fig. 1). Then they become surrounded by an extremely dense and thick layer of gland cells. The diameter here is 35—45 μ including the gland cells — the epithelium of the wall is not distinguishable from the prostate covering. The lumen is 4.5—7.5 μ wide.

The atria are very symmetrical (Pl. IX, figs. 1, 2), and the ampullae in the fixed state, somewhat compressed from the side, the height being about 80 μ, the length 65—70 μ, and the breadth about 50 μ. The muscle layer is extremely strong, 6—12 μ thick (Pl. IX, figs. 1, 2 *ml*); the epithelium is 3—7.5 μ thick. The duct (Pl. IX, fig. 2) is long, 75 μ, with the muscle layer of the ampulla continuing on it, 1.5—3 μ thick. The uppermost part of the duct is about 12 μ wide, with an inconspicuous lumen, further down the lumen is 3—6 μ wide, and the outer diameter is 18—24 μ. There are 3 penial setae per bundle, 108—110 μ long, with a simple hook.

The species lives under widely varying ecological conditions. Piguet, Bretscher, and Schuster found it only in cold, rapidly running water, and the latter claims it to be "ein stenothermes Kaltwassertier," with high oxygen demands. Hrabě, on the other hand, denies this, having found it in masses in muddy, evil-smelling, oxygen-poor water in the river Svratka. — It has also been found frequently in brackish water, with as much as $12.7\,{}^{0}/_{00}$ salinity. — In Sweden it has only been found in the brackish water of the Baltic and the gulf of Bothnia.

As Piguet has pointed out, this species swims in a peculiar manner, not with spiral movements, as the other swimming *Nais*, but with very rapid lateral waves, in a single plane (cf. p. 38).

Wolf (1928) states it to be usually found with its posterior end in the mud, the anterior part of the body projecting into the water, and making undulating movements.

Nais raviensis Stephenson, 1914.

Nais raviensis Stephenson, 1914, pp. 324—327, Figs. 1—2.
Nais raviensis Stephenson. Stephenson, 1915 b, p. 785; 1923, pp. 65—66. Michaelsen & Boldt, 1932, p. 595.
[?] *Nais tenuidentis* Walton, 1906, p. 700, Fig. 10.
[?] *Nais communis* Piguet. Stephenson, 1931 b, p. 39.

No eyes. Dorsal setae from VI on, 1 short hair per bundle and 1—2 needles, double-pronged, with short, diverging prongs, and nodulus 2/7 from the distal end; ventral setae 3—4 per bundle, those of II—V twice as long as, and slightly thinner than the rest, with nodulus proximal, and distal tooth much longer than proximal; those following with distal nodulus, and proximal prong thicker and slightly longer than distal. Stomachal dilatation inconspicuous. At least one pair of simple transverse vessels, in VI. Brain deeply bifid behind, with straight anterior border. No coelomocytes. $n = 13$. $l = 3$ mm.

India, Sumatra, Kenya?

As Stephenson (1914) points out, it is possible that *N. tenuidentis* Walton belongs here, or at least is related to *N. raviensis*, the length of the teeth of the ventral setae (of II—V?), $\frac{20\,\mu}{14\,\mu}$, being the chief distinction.

It seems probable that *N. communis* Piguet of Stephenson (1931 b) is in reality identical with *N. raviensis*. All characters given, absence of eyes, size, setal shape, and size etc. fit in with this species, but badly with *N. communis*.

The ventral setae are stated to attain 90 μ in II—V, with distal tooth 7—8 μ long, 48 μ in the rest, the needles 40 μ, the hairs 83 μ.

Nais schubarti Marcus, 1944.

Fig. 14 *D*.

Nais schubarti Marcus, 1944, pp. 52—53, Pl. X, figs. 40—41.

Dorsal setal bundles with 2 hairs and 1 spatulate needle with distal nodulus; ventral setae of II—V 3—5 per bundle, twice as long as, and thinner than the rest, with nodulus proximal, and distal tooth longer than proximal; those following 3 per bundle, with distal nodulus and teeth about equally long. Stomachal dilatation in VIII. Anus terminal. $n = 16$. l (preserved) = 2.5 mm.

S. America (Brazil).

The hairs are stated to be 80—100 μ long, the needles 50—60 μ, the anterior ventral setae 72—80 μ, the rest 40 μ. — Nothing is known of the vascular system.

The peculiar shape of the needles (Fig. 14 *D*, p. 129), and the statement that the stomachal dilatation reminds one of that of *Pristina* make the position of this species doubtful. It is rather probable that it will have to be placed in a genus of its own, but since nothing is known of the sexual organs, it seems better to wait.

*

The genus *Nais*, as limited in the present way, is on the whole very homogeneous, though two tropical, incompletely known species deviate in some respects. — Thus, *Nais raviensis*, according to the description of Stephenson (1914), is separated from the bulk of the genus in the absence of eyes, stomachal dilatation, and coelomocytes, the presence of commissural vessels in VI, and the shape of the brain, and it seems uncertain if it ought even to be placed in the genus. It is anyhow insufficiently known, and is omitted in the following survey.

The species *N. schubarti* Marcus differs in the absence of eyes, in the peculiar shape of the needles (spatulate), and possibly the stomach. The generic position of this species, too, seems doubtful, but it is too little known to allow of any conclusions in this respect. In the absence of eyes, and the unusually marked difference in length between anterior and posterior ventral setae, it resembles *N. raviensis*.

Among the rest of the species, *Nais communis* (only the European form considered) seems to be one of the most primitive, with only a slight difference in length and shape between the ventral setae of II—V and the rest, with bifid needles, a slowly dilating stomach, and spermathecal duct without dilatation. Possibly also the absence of swimming is a primitive character.

A developmental course of its own is shown by *N. elinguis*, which has retained the first three of these characters, but has attained a mode of swimming of its own, and some peculiar traits in the sexual organs (exceedingly strong musculature of the atria, and excessive prostate). In fact, the differences between *N. elinguis* and the rest of the genus are so great that they might justify its separation as a different subgenus.

The two species *N. bretscheri* and *N. pardalis* form one group, characterized by special, enlarged ventral setae. They have retained the bifid needles, and *N. bretscheri* also the gentle stomachal dilatation, but they have the ventral setae of II—V strongly differentiated from the rest, and *N. pardalis* has an abruptly dilating stomach with peculiar cells, and swims like an ordinary *Nais.*

The rest of the genus may all be grouped together. They all have a sudden stomachal dilatation, and swim with spiral movements, except some non-swimming stream-forms (*N. alpina*, and probably *N. andina* and *N. behningi*). Most have a dilated spermathecal duct. *Nais variabilis*, which probably stands fairly near to *N. communis*, has bifid needles, and a poorly defined atrial duct; in *N. simplex* the needles have lost one tooth, but otherwise resemble those of the former, to which *N. simplex* is no doubt closely related. In *N. barbata*, *pseudobtusa*, and *behningi* the needles have very fine, elongated tips, and in the two former the atrial duct is long and well-defined. *N. behningi* is a very specialized type with transformed anterior ventral setae, and a very long, narrow spermathecal duct. *N. alpina* (and *andina*?), too, is specialized, very thick, with long spermathecal ducts. Its vasa deferentia have a strong prostate covering, most resembling that of the three last-mentioned forms, but it has needles and atria resembling those of *N. simplex.* It is not easy to determine its closest affinities.

It ought to be pointed out that the genus *Nais* is apparently much more abundant in temperate zones than in tropical or subtropical regions.

Several species of *Nais*, not recorded above, have been described in the earlier literature. Among these, *Nais filiformis* Blainville (1825), *N. coecilia* Mayer (1859), *N. papillosa* and *N. gigantea* Kessler (1868) are undoubtedly Tubificids (stated about the two latter species by VEJDOVSKY, 1884). *Nais albida* Carter (1858) is an Enchytraeid (as stated also by VEJDOVSKY), *Nais quadricuspida* and *marina* Fabricius (1780), *N. aequisetina* Dugès (1837), *N. picta* Dujardin (1839), and *N. Carolina* Blanchard (GAY, 1849) are probably Polychaeta. Of *Nais auricularia* Bosc (1802), and *N. bipunctata* Delle Chiaje (1822—1829) I have not been able to get the descriptions.

Genus **Slavina** Vejdovsky, 1883.

Generic type: *Slavina appendiculata* (d'Udekem).

Body wall provided with rows of sensory papillae, and usually surrounded by adhering foreign matter. Eyes present or absent. Dorsal setae beginning in IV or VI, non-serrated hairs and fine, usually simple needles, slightly curved distally. Stomach present; pharyngeal and oesophageal glands present. Coelomocytes present. Clitellum absent between male pores; vasa deferentia without prostate, joining atria above atrial duct; atria with or without prostate; penial setae present.

Slavina isochaeta Černosvitov, 1939.

Slavina isochaeta Černosvitov, 1939, pp. 88—89, Figs. 20—25.

No eyes. Dorsal setal bundles from IV, containing 2—3 thick, stiff hairs, none especially elongated, and 2—3 needles, tapering towards the distal end; ventral setae 4—5 per bundle, in II—V longer and thinner than the rest, with distal tooth half as long again as proximal; in the other segments proximal tooth almost as long as distal. Stomach beginning in IX (?). *s* = up to 43. *l* (preserved) = 2.5—4 mm. Budding not observed.

S. America (Titicaca basin).

The ventral setae of II—V are stated to be 105—115 μ long, the rest 92—98 μ, the needles 70—80 μ, the hairs 180—350 μ. The ventral setae are 3.4 μ thick.

The oesophagus is stated to join the intestine in IX; this probably represents the beginning of the stomach. — The species is very incompletely known.

Slavina sawayai Marcus, 1944.

Slavina sawayai Marcus, 1944, pp. 59—62, Pl. XII, figs. 48—49.

No eyes. Dorsal setae from IV, 1—3 hairs per bundle, those of V much longer than the rest, and 1—3 needles, with finely bifid distal end; ventral setae 6 per bundle, all with median nodulus, and distal tooth longer and much finer than proximal. Stomach beginning in VII. *s* = 180. *l* = 30 mm. Fragmentation.

S. America (Brazil).

The hairs are stated to be 300—400 μ long, 4 μ thick, with the exception of the 5th segment, where they attain 870 μ and 5 μ, respectively. The needles are 110 μ long, 3 μ thick; the ventral setae 120—140 μ long, 3.5—5 μ thick. Marcus had only one specimen.

The bifid needles are unique in the genus, also the situation of the long hair setae, in V.

Slavina appendiculata (d'Udekem, 1855).

Figs. 15 *A*, *B*, 26 *B*.

[?] *Nais escherosa* Gruithuisen, 1828, p. 409.
[?] *Nais gracilis* Leidy, 1850, p. 43, Pl. II, fig. 1.
Nais appendiculata d'Udekem, 1855, p. 552, Pl., fig. 3.
Nais appendiculata d'Udekem. d'Udekem, 1859, pp. 21—22. Vaillant, 1890, pp. 371—372. Bretscher, 1896, p. 508.
[?] *Nais gracilis* Leidy. d'Udekem, 1859, p. 22. Vaillant, 1890, pp. 372—373. Beddard, 1895, p. 287.
Slavina appendiculata (d'Udekem). Vejdovsky, 1883, p. 219; 1884, p. 30, Pl. III, figs. 17—26. Štolc, 1886, pp. 503—504. Bousfield, 1886 a, pp. 264—268, Pl. XXXIII, figs. 1—4. Bourne, 1891, p. 345. Beddard, 1895, p. 287. Bretscher,

1900, p. 14. MICHAELSEN, 1900, p. 32; 1903 b, pp. 185—186; 1909 a, p. 13, Figs. 17—18; 1913, pp. 207—208. PIGUET, 1906, pp. 282—287, Pl. XII, fig. 20. GALLOWAY, 1911, p. 303. PIGUET & BRETSCHER, 1913, pp. 47—48. SCHUSTER, 1915, pp. 34—35, 68—69. SMITH, 1918, p. 639. STEPHENSON, 1923, pp. 82—83, Figs. 28—29. SVETLOV, 1924, p. 191. MALEVICH, 1927, pp. 5—6. WOLF, 1928, p. 391. UDE, 1929, pp. 42—43, Figs. 51—52. CHEN, 1940, pp. 43—44, Fig. 10. MARCUS, 1944, pp. 54—57, Pl. X, fig. 42, Pl. XI, figs. 43—44, 50.

Nais lurida TIMM, 1883, p. 153, Pl. XI, fig. 25.

[?] *Slavina gracilis* (Leidy). VEJDOVSKY, 1884, p. 30. MICHAELSEN, 1900, p. 33. MOORE, 1905 a, p. 167. GALLOWAY, 1911, p. 303.

Nais lurida Timm. DIEFFENBACH, 1885, pp. 104—106. BRETSCHER, 1899, pp. 390—391. BEDDARD, 1895, pp. 287—288. BRETSCHER, 1900, p. 15.

Slavina lurida (Timm). BOUSFIELD, 1886 a, p. 268.

Slavina punjabensis STEPHENSON, 1909 a, pp. 272—277, Pl. XIX, figs. 41—45, Pl. XX, figs. 50—52.

Slavina punjabensis Stephenson. STEPHENSON, 1915 c, pp. 793—795, Pl. LXXX, figs. 4—5. MEHRA, 1925, pp. 413, 414, Pl. XXXV, fig. 1.

[?] *Slavina sp.* STEPHENSON, 1916, pp. 301—302, Pl. XXX, fig. 1.

[?] *Slavina montana* STEPHENSON, 1923, p. 84, Fig. 30.

Eyes present. Dorsal setal bundles from VI on, consisting of 1—2 stout hairs, — in VI 1—3 per bundle, strongly elongated —, and 1—2 straight needles with distal part effilated, and tip often slightly distended; ventral setae 2—5 per bundle, in II—V thinner, and in II slightly longer than the rest, all with proximal nodulus, an angular proximal bend, and distal tooth thinner and slightly longer than proximal. Pharynx in II—IV; stomach in VII or VIII. Dorsal vessel situated mid-dorsally; commissural vessels in II—V forming a net-work. Clitellum in V—VII; spermathecal ampulla long, extending back into the sperm-sac, duct long, narrow; male funnels cup-shaped, vasa deferentia narrow, entering atria immediately above atrial duct; atria large, thick-walled, with scattered prostate gland cells, atrial duct short, narrow; penial setae 3 per bundle, with a simple, sharply curved hook. $n = 19—29$. $s = 23—46$. $l = 2—20$ mm. No swimming.

Europe, N. and S. America, S. and E. Asia.

Sweden: Waters in Småland, Närke and Lapland (ALMSTEDT, 1946); Viggsjön, Bondkroken (I. ARWIDSSON coll.); Kälarne (T. BORGH coll.); Valloxen, Metsjön, Fyrisån, Trehörningen, ponds at Uppsala, Siljan, Åkerö tjärn, Hällsjön, Storån, small lake W. of Foskros, Gersjön, Lilla Gladaviken, Kyrksjön, Missjön, Vallsträsket.

Slavina punjabensis Stephenson was shown by MICHAELSEN (1913) to be identical with *Sl. appendiculata.* — As to *Slavina gracilis* (Leidy) it is very difficult to form a definite opinion, but it seems most probable that it belongs here, too. The length of the hair setae, 457—648 μ in VI, about 305 μ in the rest, agrees. In the description and figure no hint is made about presence of papillae and the usual envelope of adhering matter. This would seem to make a separation necessary, but on the other hand, MOORE (1905 a), who is the only one to have identified his own finds with LEIDY's species, reports both characters in his specimens. MARCUS (1944) recommends referring it to *Nais*, but this seems excluded.

The extreme measurements of the setae of *Sl. appendiculata* that I have found are: ventral setae of II 111—147 μ, in the other segments 98—135 μ (Fig. 15 *A*, p. 145), hair setae of VI up to 800 μ, the rest 270—450 μ, needles 50—70 μ long. MARCUS reports 170 μ in II. MARCUS also reports needle setae with a finely tapering distal end, whereas I found, like PIGUET (1906), always a slight distension at this end (Fig. 15 *B*, p. 145). The needles are very fine, about 1.5 μ, the hairs being 3 μ thick.

PIGUET states that the stomach begins in VIII; I found it in VII.

MICHAELSEN (1913) supposes VEJDOVSKY's (1884) statement that the vascular system "verhält sich wie bei *Nais elinguis*" to be erroneous, insofar as it indicates simple transverse loops in the anterior segments; I found these vessels to be, in fact, plexiform.

The genital organs have been described by STEPHENSON (1915 c) and MEHRA (1925) (for "*Slavina punjabensis*") and, recently, by CHEN (1940) and MARCUS (1944). As these descriptions differ from each other in some points, I will give some data, from one fully mature specimen.

The spermathecal ampulla is long, at least 230 μ, and is strongly constricted where it enters the sperm-sac. The two ampullae fill up the front part of the sperm-sac in VI, winding round each other (Fig. 26 *B*, p. 249). Thus, the form of the ampulla may vary considerably, as in CHEN's specimens it was tubular with a dilation at the posterior end (cf. op. cit., Fig. 10), whereas MARCUS figures it as fairly even, without constrictions. — The duct is long, about 90 μ, much longer than in CHEN's figure, more like that of MARCUS' specimens. — The vasa deferentia make a long curve downwards, as shown in STEPHENSON's and MARCUS' figures, entering the atria immediately above the atrial duct. They are about 110 μ long, 15 μ wide, with thick, faintly glandular walls. – The atria are large, roundish or pear-shaped, inclined backwards, about 80 μ in diameter, with a thick epithelium of glandular cells, as shown by MEHRA and MARCUS. STEPHENSON, MEHRA, and MARCUS found prostate gland cells all around the ampulla, CHEN only round the opening of the vas deferens. I found it to attain maximum density above this opening, being wholly absent from the posterior face, where the epithelium is also thinner and not or only faintly glandular, as in *Vejdovskyella comata* (Fig. 26 *C*). The ejaculatory duct is short, thin and narrow, its walls not consisting of columnar cells.

Slavina montana Stephenson (1923; = *Sl. sp.* Stephenson, 1916) was stated to have no eyes, 1 hair seta, 250 μ long, not elongated in VI, 1 fine needle, 50—60 μ long, with effilated distal end, and ventral setae 3—4 per bundle, 125—135 μ long, with nodulus proximal, and distal tooth slightly longer and thinner than proximal. The stomach is in VII. $s = 47—48$. l (preserved) = 5—5.5 mm. — This form probably belongs to *Sl. appendiculata*. It was described from 3 preserved specimens only. The elongated hairs may have dropped out, and the absence of eyes may be occasional (cf. e. g. *Nais communis, Stylaria fossularis*). The tip of the needles is stated to taper to a point, thus presumably lacking the swelling in *Sl. appendiculata*, but on the other hand the latter was reported by MARCUS (1944) to have tapering needles.

Slavina evelinae (Marcus, 1942).

Peloscolex evelinae MARCUS, 1942, pp. 157—162, Pl. I.
Slavina evelinae (Marcus). MARCUS, 1944, pp. 57—59, Pl. X, fig. 45, Pl. XI, figs. 46—47.

No eyes. Dorsal setae from VI onwards, 1 hair, none elongated, and 1 fine needle with thickened distal end; ventral setae 1—4 per bundle, in II—V shorter and thinner than the rest in immature specimens, longer in mature ones, with teeth equally long, the proximal being thicker; in the other segments proximal tooth longer and much thicker than distal; on maturity all setae longer. Stomachal dilatation in X. Clitellum in V—VII; spermathecal ampulla long, entering the sperm-sac, duct long, narrow; opening of male funnels oblique, dorsal wall extremely long; vasa deferentia very short, opening closely above atrial duct; atrial ampulla large, ovoid, strongly reflected backwards, with thick, glandular epithelium, without any prostate gland cells; atrial duct long, narrow, thin-walled, curved, the two ducts opening into a small common "ejaculatory chamber," eversible, with thick, muscular wall; one penial seta with a strongly curved distal hook present on each side, in front of the atrial ducts. $s = 150$—180. $l = 30$ mm. Fragmentation.

S. America (Brazil).

The hairs are stated to be about 170 μ long, or up to 200 μ in mature specimens, the needles 35—40 μ, and 47 μ respectively, the ventral setae of II—V 108 μ, 3 μ thick, the rest 120 μ, 5 μ thick, in immature specimens, and 170 μ, and 130—165 μ respectively in mature ones, the length diminishing backwards. Thus, in the latter case, the anterior ventral setae are the longest, as in the preceding species.

This species is extremely peculiar, and its place in *Slavina* doubtful. Its setal characters are very similar to those of *Sl. appendiculata*, but its male efferent apparatus is aberrant, especially the atria, with a glandular epithelium, but without prostate covering.

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The genus *Slavina* is fairly heterogenous, yet there are several important characters common to at least some of the species. The ventral setae (Fig. 15 *A*, p. 145) have a form very similar to that of the corresponding setae in *Vejdovskyella comata*, almost straight, with a proximal nodulus, and an angular proximal bend. *Slavina sawayai* forms an exception, the nodulus being median and the proximal part evenly curved. The latter has also needles shaped otherwise than the majority, not being effilated at the distal end, which is bifid. In *Sl. isochaeta*, too, the needles have a curved, tapering, but not effilated tip, though it is simple, and both species have a hint of a nodulus. In both, the dorsal setae begin in IV; they thus seem to be more closely related to each other than to the other members of the genus. Among the latter, *Sl. evelinae*, though very aberrant in some respects, seems to have the same shape and relative size of ventral setae, and similar needles, as *Sl. appendiculata*, at least in mature specimens. The sexual organs, though so strikingly different from those of *Sl. appendiculata*, yet show some unmistakable traces common with the latter. Thus, the spermathecae are quite similar, with the long narrow duct, and extremely long ampulla. The vasa deferentia open near the atrial duct, and the latter, though much longer than in *Sl. appendiculata*, is very narrow, and the wall is thin, consisting of non-cylindrical cells. The penial setae are also fairly similar, with the unusually sharply curved distal hook. The extreme length of the lower, originally dorsal wall of the male funnels in *Sl. evelinae* is not quite unparalleled; in *Stylaria lacustris* (p. 149) it is much elongated, too, though not to the same degree. The fact that the two ejaculatory ducts open in common in an eversible chamber (though it seems to be very small) is a fairly strong difference between the two species, and the absence of prostate gland cells on the atria, too; the differences would perhaps justify the erection of a new genus for *Sl. evelinae*, but as the species is so obviously related to *Slavina*, this does not seem quite necessary.

Genus **Vejdovskyella** Michaelsen, 1903.

Generic type: *Vejdovskyella comata* (Vejdovsky).

Eyes present or absent. Dorsal setae from V or VI, stout, serrated hairs, and fine, straight, simple-pointed needles without nodulus, with effilated distal end; ventral setae of II—V of similar shape as the posterior. Stomach present; pharyngeal and oesophageal glands present. Dorsal vessel situated dorsally; vascular loops in several anterior segments. Coelomocytes present. Clitellum absent between male pores; atria with prostate gland cells; vasa deferentia without; penial setae present.

The genus *Macrochaetina* Bretscher (1899), was included within *Vejdovskyella* by Piguet (1928).[1]

Vejdovskyella comata (Vejdovsky, 1883).

Figs. 15 *C—F*, 26 *A*.

Bohemilla comata Vejdovsky, 1883, p. 218.
Nais hamata Timm, 1883, pp. 152—153, Pl. XI, fig. 24.

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[1] Strand (1928) changed the name *Bohemilla* Vejdovsky for *Bohemillula*, on account of the former being preoccupied; apparently he was not aware that it had already been changed by Michaelsen (1903).

Bohemilla comata Vejdovsky. Vejdovsky, 1884, p. 28, Pl. II, figs. 1—7. Vaillant, 1890, pp. 376—377. Bourne, 1891, pp. 344—345. Michaelsen, 1900, p. 30.
Vejdovskyella comata (Vejdovsky). Michaelsen, 1903 b, p. 184; 1909 a, p. 22, Fig. 31. Maule, 1906, pp. 302—305. Southern, 1909, p. 134. Kleiber, 1911, p. 23. Piguet & Bretscher, 1913, p. 45. Schuster, 1915, pp. 27—34, 67—68, Figs. 15—21. Hayden, 1922, p. 167. Piguet, 1928, pp. 83—84. Wolf, 1928, p. 390, Fig. 5. Ude, 1929, pp. 37—38, Figs. 44—46. Černosvitov, 1942 a, p. 206.
Vejdovskyella comata (Vejd.) var. *scotica* Stephenson, 1922 b, pp. 281—282, Fig. 1.
Vejdovskyella comata var. *scotica* Stephenson. Piguet, 1928, p. 86.
[?] *Vejdovskyella sp.?* Altman, 1936, p. 14.

Eyes present. Body-wall with scattered papillae. Dorsal setal bundles from V onwards, consisting of 4—8 hairs, and 1—8 needles; ventral setae all comparatively straight, with a proximal bend, with longer distal prong, and proximal nodulus; in II longer and thicker than the rest, in IV shorter and fewer, or missing. Pharynx in II—IV; stomachal dilatation in VIII. Vascular commissures in II—V, in II branching, or those of II and III anastomosing. Clitellum in V—1/2 VIII; spermathecal ampulla small, duct very long, sometimes extending back into the sperm-sac; vasa deferentia strongly curved, entering atria at lower part of anterior face; atrial ampulla spherical, duct short; penial setae 1 per bundle, with a simple distal hook. $n = 12—24$. $s = 24—34$. $l = 2—8$ mm. No swimming.

Europe, N. America.

Sweden: Waters in Småland and Lapland (Almstedt, 1946); Öjaren (zool. mus., Uppsala); Rengen (S. Berg coll.); Åkerö tjärn, Övre Hågåsjön, Gersjön, Lilla Gladaviken, Älgträsket, Vallsträsket, Kyrksjön, Missjön, several ponds.

Vejdovskyella comata var. *scotica* Stephenson must be considered identical with the common form (cf. below). — *Vejdovskyella sp.?* Altman was published without any description.

There has been some discussion about the serration of the hairs. Vejdovsky (1884, Pl. II, figs. 2—3) drew the serrations on the concave side of the setae, Timm (1883, Pl. XI, fig. 24 B) and Schuster (1915, Fig. 15 d) on the convex side, while Kleiber (1911) saw on some setae a double row. — Stephenson (1922 b) created the var. *scotica*, mainly based on the distinction that the serrations were on the convex side instead of the concave, as in Vejdovsky's figure. I have found that there are, in fact, two rows of serrations in the common form. They are situated more to the convex side, and mostly only one row shows, on this side, at a low or medium magnification. According to the side from which the seta is viewed it may, however, appear serrated on the concave side, on both sides, or not at all (Fig. 15 E_1—E_3, p. 145). — As can be seen from the figure, the basal end of the hairs is tapering and pointed, in contrast to the common hairs.

Below is a table of seta measurements in μ from one specimen:

	v.s. II	v.s. III	v.s. IV	v.s. V	v.s. VI	v.s. post.	n.s.	h.s.
number	4	3	0–1	2–3	4	3–4	5–6	5–6
length......	85	74–75	58	64–66	62–64	51–62	67–90	200–375
thickn......	1.5 1.7	1.3	1	1.3	1.3	1.3	1.5–1.7	3 3.5

The extreme lengths have been: ventral setae of II, 80—90 μ, of IV, 55—58 μ, of the following segments 51—66 μ, needles 67—90 μ, hairs 170—375 μ. The hairs are very stout and the serrations were about 10 μ long. For the shape of the ventral and needle setae see Fig. 15 *C*, *D*, *F*.

The above needle measurements are considerably larger than those given by SCHUSTER (47—52 μ). — ČERNOSVITOV (1942 b) reports specimens from the river Ural with enormously long anterior ventral setae, 204 μ long in II, 108 μ in III, but normally long in the rest, though not shorter in IV — 70 μ — than in V—IX — 56—64 μ. — SCHUSTER's other measurements are: ventral setae of II 84 μ, of III 72 μ, of the rest 53—57 μ, hairs 332—341 μ.

The stomach is represented by a slow or abrupt swelling in VIII, narrowing into the intestine in IX. It is not at all as conspicuous as in VEJDOVSKY's figure (op. cit., Pl. II, fig. 2). — The oesophagus has a slight dilatation in VI—VII, recorded by SCHUSTER, STEPHENSON, and WOLF, and often assumed to represent the stomach. Its structure, however, does not seem to be different from that of the oesophagus. — The septal glands recorded by SCHUSTER in II—IV are certainly the pharyngeal glands, which are well developed.

The dorsal vessel is situated dorsally, a little to the left of the middle line.

I have one specimen with fully developed sexual organs. They diverge in some respects from the description given by SCHUSTER, so here is an account of them. — The testes and ovaries have disappeared. — The spermathecae have extraordinarily long ducts, the one about 80 μ long, the other about 135 μ, with a diameter of 13—16 μ, and small ampullae, 35—50 μ long, 20 μ wide. The longer spermatheca of this specimen extends back into the sperm-sac, through the whole of VI (Fig. 26 *A*, p. 249). The ducts have a very narrow lumen.

The male funnels are cup-shaped and face outwards and backwards. They lie at the same level, not one above the other, as in SCHUSTER's specimens. The vasa deferentia, with a length of about 160 μ, and a diameter of 10 μ, make a sharp bend downwards and outwards, and join the atria at their anterior wall, some distance above the duct. The wall of the vasa deferentia is 2.5 μ thick.

One atrium is spherical, 50 μ in diameter, the other is lengthened, about 85 μ long, 50 μ wide. They are covered with pear-shaped gland cells, 15—20 μ long. The gland cells are most densely set on the anterior half, behind this they become scattered, and on the posterior wall they are absent (Fig. 26 *A*). The atrial wall has a well developed muscular layer, and in the posterior wall an epithelium of fairly small, flattened cells, like those in SCHUSTER's Fig. 19. In the other parts of the atrium, however, the epithelium consists of very large, long, glandular cells, the ends of which project into the lumen, almost filling it. — The ejaculatory ducts are not sharply marked off, though more so than in SCHUSTER's Fig. 17. They are about 30 μ long, 15 μ thick, with walls of columnar cells. They are surrounded by gland cells of smaller size, less granular than those surrounding the ampulla. — The penial setae resemble that in SCHUSTER's Fig. 15 b, but are not so sharply hooked.

The female funnels are situated at half the height of the lateral body walls in VI. They are unusually large, projecting trumpet-like into the coelom, attached to the anterior wall of septum 6/7. They are about 45 μ long, with an inner diameter of 13 μ. — The sperm-sac extends through IX, the ovisac through XI.

SCHUSTER (1915, p. 30) states that the formation of budding-zones takes place in the same order as in *Nais*, i. e. the fourth zooid is formed behind the second, and not between the first and the third, as in *Stylaria*. He does not, however, mention if one segment from the zooid in front is included within the new zooid, as in *Stylaria* and *Vejdovskyella intermedia*. I have, unfortunately, not found chains permitting an analysis of the subject.

Vejdovskyella intermedia (Bretscher, 1896).

Macrochaeta intermedia BRETSCHER, 1896, pp. 509—510.

Macrochaetina intermedia (Bretscher). BRETSCHER, 1899, p. 392. MICHAELSEN, 1900, p. 31; 1909 a, p. 21, Fig. 30; 1926 c, p. 5. PIGUET, 1906, pp. 279—282, Pl. XII, fig. 19. PIGUET & BRETSCHER, 1913, p. 46. EKMAN, 1915, pp. 147, 287. WOLF, 1928, pp. 391—393.

Vejdovskyella intermedia (Bretscher). PIGUET, 1928, pp. 86—87, Fig. 3. UDE, 1929, pp. 38—39, Fig. 47.

No eyes. Epithelium of body-wall with dense gland cells, sometimes with adhering foreign matter. Dorsal setae from VI, 4—9 serrated hairs, and 4—9 fine needles per bundle, ventral setae of II—V, 2—4 per bundle, of the same shape as the common posterior setae, with longer distal prong, and proximal nodulus, those of II being longer than the rest; from VI backwards only 1 seta per bundle, in VI, and often in one or more following segments, the common seta usually being replaced by a very thick seta with large proximal prong, and 2—3 fine distal prongs. Dilatation of the alimentary canal in VI—VII. Commissural vessels at least in IV—VI. Budding of the *Stylaria* type. $n = 11—14$. $l = 1.3—3$ mm. No swimming.

Europe.

Sweden: Vättern (EKMAN, 1915).

The hair setae are stated in the literature to be 213—341 μ long, the serrations being 4—5 μ long. The needles are 56—66 μ long, the ventral setae of II, 105 μ long, diminishing in size in III—V, in the rest of the body 66—72 μ long, inclusive of the thick setae.

The occurrence of enlarged setae in some of the ventral bundles is reminiscent of the state in *Nais bretscheri* and *N. pardalis*, though they are stated by WOLF to be already found in the posterior zooids before separation, contrary to the state in *Nais*.

Vejdovskyella macrochaeta Lastočkin.

Vejdovskyella macrochaeta Lastočkin. LASTOČKIN, 1937, p. 233.
Russia.

I have not been able to find the description of this species.

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The most striking difference between the two species *V. comata* and *intermedia* seems to be the presence of very thick setae of aberrant shape in the latter. The other ventral setae, as far as appears from the literature, seem to agree well, though the difference in length between the teeth of the ventral setae seems to be greater in *V. intermedia* (PIGUET, 1906, Pl. XII, fig. 19 b, c; the form of the proximal part of the setae is not shown in the figure). The form of the needles of *V. intermedia* is not described. In *V. comata* they have an effilated distal end, like those of *Stylaria*, *Arcteonais* and *Ripistes*, and one *Slavina*. Unlike these they begin to taper from a distinct point (Fig. 15 *F*), but the tapering part is not curved, as in *Slavina*. — The above differences, as well as the point of commencement of the dorsal bundles, the weak development of the ventral setae of IV in *V. comata*, and the absence of eyes and presence of vascular loops in VI (if this holds true) in *V. intermedia*, make the erection of the genus *Macrochaetina* for the latter species by BRETSCHER appear fairly well justified. As this species is, however, not well enough described to allow of a definite opinion, I follow PIGUET here.

Genus **Arcteonais** Piguet, 1928.

Generic type: *Arcteonais lomondi* (Martin).

No pigment. Eyes present or absent. Prostomium forming a proboscis. Dorsal setae from VI, numerous, fine, smooth hairs, and fine, simple-pointed needles; ventral setae all of one shape. Stomachal dilatation present. Dorsal vessel situated mid-dorsally; vascular loops in II—V. Clitellum absent between male pores; vasa deferentia devoid of prostate; atria with prostate; penial setae present.

Arcteonais lomondi (Martin, 1907).

Fig. 15 *G*.

[*non*] *Caecaria brevirostris* Floericke, 1892, p. 470.
Caecaria brevirostris Floericke. Plotnikoff, 1901, pp. 248—249, Fig. 2. Munsterhjelm, 1905, p. 15, Pl., figs. 6—7.
Stylaria lomondi Martin, 1907, pp. 25—26, Pl. II.
Stylaria brevirostris (Floericke). Wolf, 1928, pp. 396—400, Figs. 7—9.
Arcteonais lomondi (Martin). Piguet, 1928, pp. 88—89, Fig. 4. Ude, 1929, pp. 51—52, Figs. 63—65. Malevich, 1929, pp. 45—46.

Dorsal setal bundles containing 8—18 straight, slender hairs, and 9—12 very fine needles; ventral setae 3—7 per bundle, all very slightly curved, with nodulus median or proximal, and distal tooth longer and somewhat thinner than proximal. Pharynx extending through IV; stomachal dilatation sudden, beginning in VIII. Clitellum in V—VII; spermathecal ampulla spherical, duct fairly short, well-defined; vasa deferentia strongly curved, entering atria above atrial duct; atrial ampulla reflected backwards, covered with clusters of prostate gland cells, duct inconspicuous; penial setae 4 per bundle with a simple distal hook, arranged horizontally. $n = 32$. $s = 42—50$. $l = 8—10$ mm. No swimming (?).

Europe.

Sweden: Småland: Lakes Stråken, Möckeln (Almstedt, 1946).

It has been a frequent opinion, even among recent authors (e. g. Wolf, 1928, Malevich, 1929), that the present species is identical with *Caecaria brevirostris* Floericke, which was declared by Michaelsen (1903 b, p. 186) to be, along with the two other species described in the same paper, *C. rara*, and *silesiaca*, probably only newly-budded individuals of *Stylaria lacustris*. It seems, however, that none of the species of "*Caecaria*" can have been anything like *Arcteonais*, for Floericke places the genus "in die Mitte zwischen *Stylaria* und *Pristina*" on account of the absence of eyes, and the dorsal setae beginning in VI. He does not mention anything about any unusually large number of setae, which is so striking in *Arcteonais*, and the ventral setae of "*Caecaria rara*" are stated to have a very short and stumpy lower tooth, which is very characteristic for *Stylaria*, but does not apply at all to *Arcteonais*. The other "species" will have had the same setal shape, as no difference is mentioned.

The length of the dorsal hair setae, as stated in the literature, is 222—395 μ. Malevich (1929) points out that there are, contrary to the statements of the previous authors, also needles in the bundles, extremely fine, alternating with the hairs, 62—68 μ long. The arrangement of the dorsal setae is very similar to that of the bundles in VI—VIII in *Ripistes*. — The ventral setae are all of the same shape (Fig. 15 *G*, p. 145, drawn from Munsterhjelm's material, which was lent to me from Helsingfors, thanks to the kindness of the director of the Zoological Museum Prof. Wälikan-

GAS), and fairly similar to the setae of II in *Ripistes parasita* (cf. Fig. 15 *H*). They are stated to be 144—149 μ long in II, in III—V gradually diminishing in length, being 110—128 μ in the remaining segments.

The vascular system was stated by WOLF (1928, p. 398) to be similar to that of *Stylaria lacustris*. The figure (loc. cit., Fig. 9), however, gives free loops in IV and V, one free and one branching vessel in III, and one branch from the right part of the dorsal vessel in front of the bifurcation, whereas in *Stylaria* there are free, simple loops in II—V.

The sexual organs, described by PIGUET (1928), are strongly reminiscent of those of *Ripistes parasita* (cf. p. 146).

Genus **Ripistes** Dujardin, 1842.

Generic type: *Ripistes parasita* (Schmidt).

Eyes present. Pigment present. Prostomium forming a proboscis. Dorsal setae from VI, smooth hair setae, in VI—VIII strongly elongated, and straight, single-pointed needles without nodulus. Pharyngeal and oesophageal glands present; stomach present. Dorsal vessel situated dorsally; vascular commissures simple or branching. Clitellum absent between male pores; vasa deferentia without, atria with prostate; penial setae present.

Ripistes parasita (Schmidt, 1847).

Figs. 15 *H—K*, 16, 26 *C*; Pl. IX, figs. 4—7.

Ripistes DUJARDIN, 1842, p. 93.
Stylaria parasita SCHMIDT, 1847, p. 320.
Nais parasita (Schmidt). GRUBE, 1851, p. 104.
Pterostylarides parasita (Schmidt). CZERNIAVSKY, 1880, p. 310. BOURNE, 1891, p. 348.
Stylaria parasita Schmidt. VEJDOVSKY, 1883, p. 219; 1884, p. 31, Pl. II, figs. 8—12. VAILLANT, 1890, p. 365.
Pterostylarides macrochaeta BOURNE, 1891, p. 349, Pl. XXVI, fig. 1.
Ripistes parasitica (Schmidt). BEDDARD, 1895, p. 293—294.
Ripistes macrochaeta (Bourne). BEDDARD, 1895, p. 294. MICHAELSEN, 1900, p. 32; 1909 a, p. 14. SCHUSTER, 1915, pp. 35—39, 69, Figs. 22—24. LASTOČKIN, 1924 b [*fide* MALEVICH, 1925]. MALEVICH, 1925, p. 66. CORI, 1928, pp. 67—73, Figs. 1—2.
Ripistes parasita (Schmidt). MICHAELSEN, 1900, p. 31; 1905 c, p. 5; 1909 a, p. 14, Fig. 19. UDE, 1929, pp. 39—40, Fig. 48. MALEVICH, 1929, pp. 44—45. PESSON, 1938, p. 39.
Ripistes rubra LASTOČKIN, 1918.
Ripistes rubra Lastočkin. SVETLOV, 1924, pp. 191—192. UDE, 1929, pp. 40—41. LASTOČKIN, 1937, p. 233.

Dorsal setal bundles in VI—VIII consisting of 2—16 giant hair setae, 2—6 short hairs, and 10—18 needles; in the following segments 1—3 moderately long hairs, and 1—3 needles; ventral setae of IV—V absent, those of II and III 2—7 per bundle, finer than the rest, with proximal nodulus and longer distal tooth; in the remaining segments 3—8 per bundle, nodulus distal, and distal prong slightly shorter than proximal. Stomachal dilatation sudden, beginning in VI or VII. Dorsal vessel mid-dorsal, or slightly to the left; vascular commissures in III—V, those of III branching. Clitellum in 1/2 V—1/2 VIII; spermathecal ampulla large, bag-like, duct fairly long, well-defined; vasa deferentia opening above atrial duct; atrial ampulla reflected backwards, duct short, poorly defined; penial setae 2 per bundle, with a simple hook. $n =$ 14—21. $s =$ 23—30 (in mature specimens 27—39). $l =$ 2—7.5 mm. Swims with sagittal movements. Constructs fixed, hyaline tubes.

Europe, Baical.

Sweden: Waters in Småland and Närke (Almstedt, 1946); Öjaren (zool. mus. Uppsala); Rengen (S. Berg coll.); Trehörningen, Siljan, Åkerö tjärn, Gersjön, Lilla Gladaviken, Kyrksjön, Vallsträsket.

There has been some confusion as to the significance of the various forms of this species. Schuster (1915) has shown that *R. macrochaeta* Bourne, which was stated to have fewer long hairs, and a longer proboscis, must be included within *R. parasita*, intermediate forms being frequent. — Lastočkin (1918) described *Ripistes rubra*. I have not had access to this paper, but judging from the description in Ude (1929) there seems to be no difference between *R. rubra* and my specimens of *R. parasita*, other than the pigmentation in I—VIII being reddish in the former, but yellowish in the latter, and the relation of the length of the needles in VI—VIII to those of the following segments, being $^{2}/_{1}$—$^{2.5}/_{1}$ in *R. rubra*, and only about $^{3}/_{2}$ in my specimens. The statement that the ventral setae of II are 3 times as long as the rest seems to be erroneous, as Svetlov (1924) states the relation to be $^{6}/_{5}$—$^{7}/_{5}$. He found intermediates between the two types, yet did not unite them. Lastočkin himself (1924 b), according to Malevich (1929), united the forms, but later (1937) he seems to have changed his opinion again. Malevich (1929) concludes that both forms probably belong to the same, widely variable species, and this seems reasonable.

In my material, the common hair setae and needles are usually 2 per bundle, the hairs being 165—180 μ long, the needles about 60 μ, both 1.5 μ thick. In VI—VIII the bundles contain 5—16 giant hairs, about 3 μ thick and 780—1700 μ long, some shorter and finer hairs, probably growing, and 11—14 needles, 66—96 μ long. The needles are approximately straight and taper towards the long, fine tip.

The ventral setae of II are considerably longer than the rest, 93—99 μ, 2 μ thick, with a markedly proximal nodulus, and teeth equally thick, the distal being longer, $\frac{6\text{—}7.5\ \mu}{3.5\text{—}4.5\ \mu}$ (Fig. 15 *H*). They are slightly and evenly S-curved. Contrary to the state common in the family, the following setae are straighter than those of II, though with a sharp, proximal bend. In III the nodulus is still proximal, and the distal tooth is longer

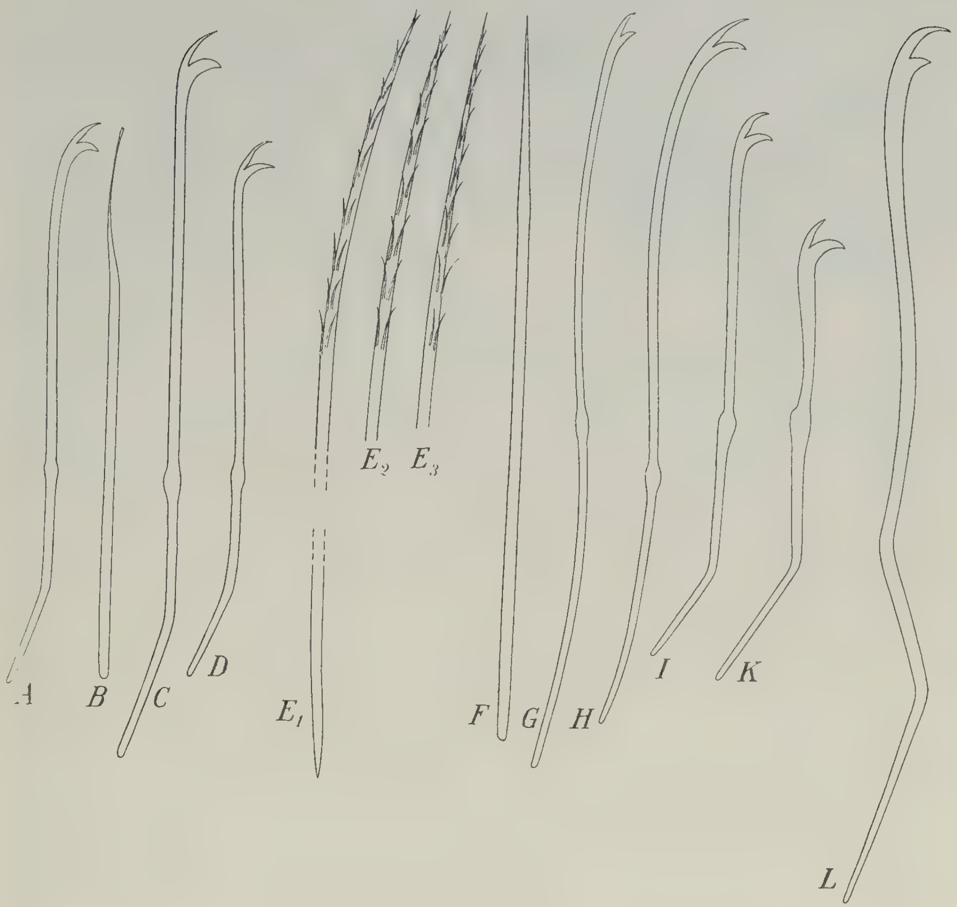

Fig. 15. *A*, *B* *Slavina appendiculata*. *A* ventral seta from a posterior segment, *B* needle seta. *C*-*F* *Vejdovskyella comata*. *C* ventral seta from II, *D* from a posterior segment, E_1-E_3 hair seta, different views, *F* needle seta. *G* *Arcteonais lomondi*. Ventral seta. *H*-*K* *Ripistes parasita*. Ventral setae, *H* from II, *I* from III, *K* from a posterior segment. *L* *Stylaria lacustris*. Ventral seta. *A*, *E*, *L* 600 ×, *B*, *C*, *D*, *F* 1200 ×, *G*-*K* 900 ×.

(Fig. 15 *I*), but from VI onwards the nodulus is distal, the proximal tooth is longer and considerably thicker, and the whole shape is somewhat peculiar (Fig. 15 *K*). In III the length is 67—78 μ, the thickness 2 μ, the length of the teeth $\frac{5\ \mu}{4.5\ \mu}$; in the segments from VI backwards the length is 66—72 μ, the thickness at the stoutest point of the innermost seta in a bundle being 2 μ, increasing to 3 μ in the most lateral seta. The lengths of the teeth are $\frac{3.5—4.5\ \mu}{5\ \mu}$. — The measurements found in the literature are: ventral setae of II 60—80 μ, the rest 20 μ shorter (SCHUSTER, 1915); elongated hairs 1 350—1 700 μ.

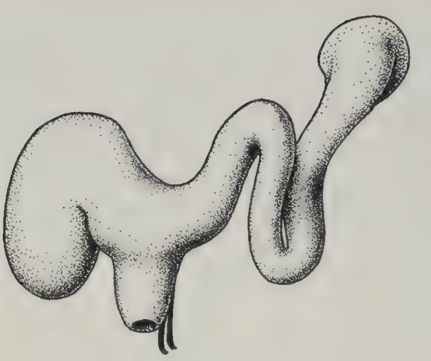

Fig. 16. *Ripistes parasita.* Right male efferent apparatus, oblique frontal view. Reconstruction in plastiline. 450 ×.

The stomach in the present material was situated in VII. — Schuster's statement: "Die Septaldrüse ist mässig entwickelt und beschränkt sich auf das 2. Segment" seems cryptic. He probably means the pharyngeal gland mass, which chiefly occupies III.

The only statement about the vascular system found in the literature is Cori's (1928, p. 70), who found pulsating commissures in VI—VIII. In the present material, simple loops are found in IV and V, and in III a loop, branching once ventrally, but no vessels in other segments. The dorsal vessel is usually slightly left-sided.

n was = 19, s in immature specimens = 21—30, in mature = 27—39. The budding is of the "type stylarienne" (cf. Dehorne, 1916, Cori, 1928).

I found a considerable number of sexually mature specimens from which the gonads had disappeared. — The clitellum stretches from $^1/_2$ V to $^1/_2$ VIII. The dorsal setae of the clitellar region are not shed.

The spermathecae (Pl. IX, fig. 4) have a large, thin-walled ampulla, up to 105 μ high, when filled with sperm, the two ampullae filling up most of the free space of V. The duct is well-defined, 40—50 μ long, 16 μ thick, with a narrow lumen.

The male funnels (Figs. 16, 26 *C*, p. 249, Pl. IX, fig. 5) are relatively very large, about 45 μ long, 25 μ in diameter. Their wall is thick, 9 μ, at the beginning of the vas deferens, but thin, 3 μ, at the mouth. They open backwards into the sperm-sac. The vasa deferentia, devoid of prostate, (Fig. 26 *C*, Pl. IX, fig. 5) make a couple of bends before joining the atria at the anterior side, slightly above the male duct. They are about 140 μ long, 12—14 μ thick, with walls 3—4 μ thick, of cubical, somewhat glandular cells.

The atria are of moderate size, elongated backwards (Figs. 16, 26 *C*, Pl. IX, figs. 5, 7), about 65 μ long, with walls 6—8 μ thick, and with scattered clusters of gland cells on the outer side. The muscle-layer of the atrial wall is thin, 1.5 μ; thus, the epithelium is very thick, consisting of large, granular gland cells. The posterior wall is thinner, its cells not or faintly glandular; it is devoid of prostate covering. — The atrial ducts (Pl. IX, fig. 7) are about 15 μ long, not distinctly marked off from the atria, with thin walls, not consisting of columnar cells, and a wide lumen.

Two penial setae are situated medially to each atrial duct. They are about 55 μ long, 4 μ thick, with a simple, thick hook (Pl. IX, fig. 6). There is no distinct nodulus, but 9—10 μ from the tip a sudden swelling occurs, forming something like a shelf round the seta.

The female funnels are inconspicuous, situated more ventrally than usual in the lateral walls of VI, immediately in front of septum 6/7. The sperm-sac extends back into XI, the egg-sac through XII.

For the mode of nutrition see p. 35. For the formation and construction of the tubes see Cori (1928, p. 68).

Stylaria Lamarck, 1816.

Generic type: *Stylaria lacustris* (Linnaeus).

Eyes normally present. Pigment present. Prostomium forming a proboscis. Dorsal setae from VI, hairs and straight, simple-pointed needles without nodulus; ventral setae all with proximal tooth weak, nodulus proximal, distal part of setae straight, proximal part angularly bent. Pharyngeal and oesophageal glands present; stomach present. Simple transverse vessels in II—V; dorsal vessel in the middle line. Coelomocytes present. Clitellum absent round male pores; vasa deferentia with or without prostate glands on their hindmost part; atria with prostate glands; penial setae present.

Stylaria lacustris (Linnaeus, 1767).

Fig. 15 *L*; Pl. X, XI.

Mille-pieds à dard Trembley, 1744, pp. 80—81, Pl. VI, fig. 1. Reaumur, 1748, p. LXX.

Das Wasserschlänglein mit dem langen, zungenähnlichen Fühlhorn Rösel von Rosenhof, 1755, pp. 483—486, Pl. XVIII, figs. 17—18, Pl. XIX, fig. 1.

Das Stachelschlänglein Ledermüller, 1763, pp. 161—163, Pl. XXXII, f, g, h.

Nereis lacustris Linnaeus, 1767, p. 1085 [*partim*].

Die gezüngelte Naide Müller, 1771, pp. 14—73, Pl. I.

Nais proboscidea Müller, 1773, pp. 21—22.

Nais proboscidea Müller. Müller, 1776, p. 219. Gmelin, 1788—1793, p. 3121. Modeer, 1798, pp. 124—128. Oken, 1815, p. 364. Gruithuisen, 1823, pp. 233—248, Pl. XXXV. Blainville, 1825, p. 131; 1828, p. 498. Tabl. enc. méth., 1827, p. 134, Pl. LIII, figs. 3—8. Grube, 1851, p. 104. Dalyell, 1853, p. 132, Pl. XVII, figs. 6—7. d'Udekem, 1855, p. 550; 1856, pp. 53—58, Pl. III, figs. 17—21; 1859, p. 19. Semper, 1877, pp. 73—75, 84—85, 87—88, Pl. III, figs. 1—3, 9—17. Timm, 1883, p. 153. Levinsen, 1884, pp. 218—219.

Stylaria paludosa Lamarck, 1816, pp. 223—224.

Stylaria proboscidea (Müller). Ehrenberg, 1828, p. 112. Tauber, 1873, pp. 405—414, Pl. XIV; 1879, p. 73. Vejdovsky, 1883, p. 219. Chen, 1940, pp. 44—46, Fig. 11.

Stylinais proboscidea (Müller). Gervais, 1838, pp. 17—18.

Stylaria paludosa Lamarck. Ørsted, 1842, pp. 133—134. Leidy, 1852 c, pp. 286—287. Czerniavsky, 1880, p. 309.

Stylaria lacustris (Linnaeus). Johnston, 1845, p. 443; 1865, p. 70. Vejdovsky, 1884, p. 30, Pl. III, fig. 27, Pl. IV. Vaillant, 1890, pp. 362—363. Bourne 1891, pp. 346—347, Pl. XXVII, figs. 7—10. Ferronière, 1899, pp. 257—258. Michaelsen, 1900, p. 33 [*partim*]; 1903 b, p. 186; 1905 c, p. 5; 1909 a, pp. 14—15, Fig. 20;

1926 a, p. 22; 1927 a, pp. 9—10, Fig. 4. Trybom, 1901, pp. 25, 28. Ditlevsen, 1904, pp. 459—461, 469—471. Munsterhjelm, 1905, pp. 14—15. Moore, 1905 a, p. 167. Piguet, 1906, pp. 287—290; 1909, pp. 209—210, Pl. III, fig. 19; 1919 a, p. 790; 1928, p. 87. Walton, 1906, pp. 693—695, Fig. 6 [*partim*]. Galloway, 1911, p. 303 [*partim*]. Piguet & Bretcher, 1913, pp. 48—49. Schuster, 1915, pp. 43—48, 75—76, Figs. 28—32. Dehorne, 1916, pp. 75—90, Figs. 35—48. Smith, 1918, p. 639. Mehra, 1924, pp. 147—186, Figs. 1—5, Pl. IV, V. Wolf, 1928, pp. 295—296. Ude. 1929, pp. 41 -42, Figs. 49 -50. Černosvitov, 1930, p. 10. Berg, 1938, p. 49, Fig. 34.

Stylaria proboscidea Lamarck. Leydig, 1864, p. 10, Pl. IV, fig. 5.

Stylaria phyladelphiana Czerniavsky, 1880, p. 309.

Stylaria scotica Czerniavsky, 1880, p. 309.

Stylaria phyladelphiana Czerniavsky. Vaillant, 1890, p. 364.

Nais lacustris (Linnaeus). Beddard, 1895, pp. 284—285. Bretscher, 1896, p. 507.

Caecaria rara Floericke, 1892, p. 470.

Caecaria silesiaca Floericke, 1892, p. 470.

Caecaria brevirostris Floericke, 1892, p. 470.

[*non*] *Caecaria brevirostris* Floericke. Plotnikoff, 1901, p. 244, Fig. 1. Munsterhjelm, 1905, p. 15, Pl., figs. 6—7.

Eyes present. Proboscis projecting from a notch between two lateral lobes. Hairs 1—3 per bundle, finely serrated; needles 3—4 per bundle; ventral setae 4—7 per bundle, all alike. Stomachal dilatation sudden, beginning in VII or VIII. Clitellum in V—VII; spermathecal ampulla long, entering sperm-sac, duct short, well-defined; male funnels very large; vasa deferentia short, hind part covered with gland cells, opening on anterior face of atria; atrial ampulla large, with thick epithelium, covered with thick prostate glands; atrial duct inconspicuous; penial setae 2 per bundle, with a simple hook. $n = 15—35$. $s = 23—49$. $l = 5.5—18$ mm. Swims with sagittal movements in the horizontal plane.

Europe, W. Asia, N. America. Found in brackish water also (the Baltic).

Sweden: Waters from Scania to Lapland (Almstedt, 1946); Vättern (Ekman, 1915); Lapland: Sarek, Lake Kalakjaure (N. von Hofsten and G. Alm coll., Piguet, 1919 a); Bexhedasjön, Näsbysjön (Trybom, 1901); Viggsjön, Bondkroken, Röjdåfjärden (I. Arwdsson coll.); Båven (N. von Hofsten coll.); Klintsundet, the sea at Södertälje (brackish, S. Bock coll.); Börstil, Siljan (Jonhammar coll.); Anjan, Hotagen (S. Berg coll.); Öjaren (zool. mus., Uppsala); pond at Karlsborg, Brunnsviken, Ekoln, Valloxen, Metsjön, Långsjön, Trehörningen, Fyrisån, Siljan, Dalälven, Åkerö tjärn, Styrsjön, Limsjön, Opplimen, Hällsjön, Slugusjön, Kyrksjön, Lilla Gladaviken, Älgträsket, Vallsträsket, Degerträsket, Missjön.

Chen considers Müller's name *proboscidea* as the correct one, as in Linnaeus' definition of the species *Nereis lacustris* it was not mentioned whether the cephalic end was notched. This is not, of course, correct; the first name must be applied to one of the species, and to the one, for which it was first used, provided it is recognizable as a *Stylaria* at all. The definition is: "N. linearis, lingua exserta," and references are given to Trembley and Rösel, whose pictures show clearly the *lacustris* characters. Linnaeus confuses the picture by referring also to the "kleiner Wasseraal" of Schäffer (1755, Pl. III, figs. 1—3), which is a Tubificid, and by adding a description of his own, which applies also to some Tubificid, but as the name is quite clearly meant for the worm of Trembley and Rösel, with the "lingua exserta," it ought to be retained for this species.

Pl. X, fig. 1 shows a complete view of the worm. The lateral lobes of the prostomium are not clearly seen.

The ventral setae have a very peculiar form (Fig. 15 *L*, p. 145). Their length was given by Piguet (1928) for VI as up to 174 μ. I measured 159—173 μ in a specimen. Their thickness was 4—5 μ, the teeth $\frac{9.5\text{—}10.5\,\mu}{3\,\mu}$. The needles were 75—96 μ long, 3.7—4 μ thick, finely effilated at the distal end. The hairs may attain 900 μ, but most measure 600—700 μ. In a sexually mature specimen from Siljan, the lengths were: ventral setae in II, 213—222 μ, in VI, 207—213 μ, needles 102—120 μ, hairs 465—1050 μ. The penial setae, 2 per bundle, were 129—135 μ long, with a greatest width of 7 μ. The serration of the hairs which has not, to my knowledge, been recorded before, resembles that of the *Pristina* hairs; it is fine, with about 5 μ interval between the teeth.

For the various parts of the alimentary canal, and the genital organs, see the anatomical section.

The sexual organs of two mature specimens were measured. — The spermathecal ampulla was 90—100 μ in diameter, and about 500—1 000 μ long; the duct was 50—60 μ long, 20—22 μ in diameter. The upper (originally ventral) lip of the male funnels (of one specimen) was about 75 μ long, the lower (originally dorsal) lip about 180 μ. The vasa deferentia were about 150 μ long, 10 μ wide behind the funnel, 15—20 μ wide nearer to the atria. The atrial ampulla was 110—150 μ high, and 125—150 μ by 60—70 μ in the other dimensions. No ejaculatory duct was discernible. — Pl. XII, fig. 5 shows a specimen, in which after oviposition the clitellum is weak and transparent, so that the spermathecae and atria are visible.

Stylaria fossularis Leidy, 1852.

Stylaria fossularis Leidy, 1852 c, p. 287.
Stylaria fossularis Leidy. Leidy, 1852 d, pp. 350—351. Vaillant, 1890, pp. 364—365. Moore, 1905 a, pp. 167—168, Fig. 3. Smith, 1918, p. 639. Hayden, 1922, p. 167. Chen, 1940, pp. 44—46, Fig. 11.
Stylaria lacustris (L.). Michaelsen, 1900, p. 33 [*partim*]. Walton, 1906, pp. 693—695, Fig. 6 [*partim*]. Stephenson, 1909 a, p. 276, Pl. XIX, fig. 46; 1911, pp. 209—211, Fig. 3; [?] 1920, p. 200; 1923, pp. 85—86, Fig. 31 [*partim*]. Galloway, 1911, p. 303 [*partim*]. Aiyer, 1925, pp. 31—32. Yoshizawa, 1928, pp. 587—613, Figs. 1—28. Kondô, 1936, p. 384, Pl. XXIII, fig. 9.
Stylaria kempi Stephenson, 1916, pp. 303—304, Pl. XXX, fig. 2.
Stylaria kempi Stephenson. Stephenson, 1923, pp. 86—87, Fig. 32.

Eyes normally present. Proboscis projecting from the tip of the pointed prostomium. Dorsal setae 2 hairs, and 1—3 short needles per bundle; ventral setae 5—14 per bundle. Stomachal dilatation beginning in VIII. Clitellum in V—VII; spermathecal ampulla elongated, not entering sperm-sac, duct well-defined; vasa deferentia without gland cells entering atria above ejaculatory duct; atria oval, covered with gland cells, duct inconspicuous; penial setae 2—3 per bundle, with a simple hook. $n = 15—34$. $s = 18—36$. $l =$ up to 15 mm. Swims with sagittal movements in the horizontal plane.

E. and S. Asia, N. America.

The present species was united by MICHAELSEN (1900) with *Stylaria lacustris*, and was usually considered as identical with the latter. CHEN (1940), however, who examined both types, recognized the difference in shape of the anterior end with the proboscis (cf. loc. cit., Fig. 11), and separated them again. To *St. fossularis* belong all findings from India. YOSHIZAWA (1928) described the type very thoroughly from Japan, and from his paper, and the papers by STEPHENSON (1909 a, 1911) some more differences from *St. lacustris* transpire. Thus, the setae are considerably shorter in *fossularis*, the hairs being 400—600 μ long, the needles 40—50 μ, the ventral setae about 100—135 μ. The latter are also thinner, 2.3 μ according to YOSHIZAWA, and their proximal curvature seems to be much less angular, with only one bend instead of two (cf. YOSHIZAWA, 1928, Fig. 9 A, and STEPHENSON, 1909 a, Pl. XIX, fig. 46).

The sexual organs also show some difference. The spermathecal ampulla seems to be much smaller in *St. fossularis*. The vasa deferentia are wholly devoid of prostate (cf. p. 48), and enter the atria at their lower face. Other characters seem to agree, such as body size, value of n and s, vascular system, etc. The statement of CHEN that there are no coelomocytes and no stomachal dilatation do not agree with the statements of STEPHENSON and YOSHIZAWA. The former found both coelomocytes and stomach, though the latter seems to be less sudden than in *St. lacustris*, and according to the description by YOSHIZAWA, its structure wholly conforms with that of *lacustris* (cf. p. 21).

Stylaria lacustris is the sole representative of the genus in Europe, and *St. fossularis* in East and South Asia, whereas in North America both species are found, often in the same localities (LEIDY, MOORE, CHEN). In the other continents they do yet not appear to have been discovered (UDE mentions Madagascar, but I have not been able to find his source). The finds of *St. lacustris* recorded by MICHAELSEN (1905 c) from lake Baical, and by ČERNOSVITOV (1930) from Turkestan, are probably *lacustris*, as nothing is mentioned about any disagreement in appearance. On the same grounds it seems probable that those reported by STEPHENSON (1920) from Eastern Iran belong to *fossularis*.

Stylaria kempi Stephenson (1916) is no doubt only an eyeless form of *Stylaria fossularis*, agreeing with the latter in all other characters.

Piguetiella Sperber, 1939.

Generic type: *Piguetiella blanci* (Piguet).

Eyes present. Dorsal setae from VI on, hairs and double-pronged crotchets; ventral setae all of one type. Vascular system simple, with transverse vessels in I—V. Pharyngeal and oesophageal glands present; stomachal dilatation present. Coelomocytes present. Clitellum not absent round male pores; spermathecal setae present; vasa deferentia devoid of gland cells, entering atria on top; atria with prostate glands; no penial setae.

The main features distinguishing this genus from *Nais* are, apart from the habit, which strongly resembles that of *Specaria* (the non-pigmented, pink, fairly thick, slowly-moving body): the similarity of the needles to the ventral crotchets, the uniformity of the latter, and especially the characters of the sexual organs — spermathecal setae in special pockets, no penial setae, prostate glands on atria instead of vasa deferentia, the latter opening on top of the atria, and atria opening on the clitellum. — From *Specaria* it is distinguished by the same characters, except those concerning the habit, and also in the presence of eyes, and of a non-complicated vascular system, in the normal arrangement of the nephridia, the ventral opening of the very long spermathecae, and non-existence of the atrial pockets. — The differences from *Allonais* are: the presence of eyes, the shape of the needles, the presence of a distinct stomachal dilatation, of spermathecal setae, and prostate glands, and the proximal opening of the vasa deferentia.

Piguetiella blanci (Piguet, 1906).

Figs. 17, 27 *E*; Pl. XII, XIII, Pl. XIV, fig. 1.

Nais Blanci PIGUET, 1906, pp. 231—234, Pl. X, fig. 1, Pl. XI, figs. 1—3, Pl. XII, fig. 7.
Nais blanci Piguet. MICHAELSEN, 1909 a, p. 16, Fig. 21. UDE, 1929, p. 51, Fig. 62. MALEVICH, 1929, p. 46.
Nais Blanci Piguet. PIGUET & BRETSCHER, 1913, p. 35.
Piguetiella blanci (Piguet). SPERBER, 1939, pp. 1—3, 5, Fig. 1. HRABĚ, 1941, p. 4, Figs. 8—12.

No pigment. Dorsal bundles consisting of 0—3 hairs, and 2—6 bifid crotchets, entirely similar to the ventral setae, with nodulus slightly distal and distal tooth equally long as, or slightly longer than distal, but considerably thinner; ventral setae 3—9 per bundle, all of one type, those of II slightly longer than the rest. Pharynx in III—IV, oesophagus in V, stomach in VIII—IX. Transverse vessels of I—V all simple, or those of I joining those of II; dorsal vessel ventrally to the left. Clitellum in $^1/_2$ V—VII; spermathecal ampulla, when filled, very long, entering sperm-sac; duct distinct, with narrow lumen; spermathecal setae projecting through the openings of special pockets, 2 per bundle, single-pointed, or with a small proximal tooth, nodulus about median; male funnels large; vasa deferentia long; atria very large, oval, duct inconspicuous, opening on protrusion of clitellum. $n = 17—24$. $s = 24—42$. $l = 3—7$ mm. No swimming.

Europe.

Sweden: Lakes in Småland and Närke (Almstedt, 1946); Juvuln, Häggsjön (S. Berg coll.); Siljan, Lilla Gladaviken, Älgträsket.

The hair setae are very short, 84—120 μ long; the dorsal crotchets (Fig. 17 *A*) are exactly similar to the ventral ones, only slightly shorter, on an average, 72—87 μ; the ventral setae of II, 84—96 μ long, are usually slightly longer than the rest, which are 75—93 μ. The difference in thickness between the teeth is greater than is shown by Piguet's figure (Piguet, 1906, Pl. XII, fig. 7). Piguet's measurements are slightly smaller; ventral setae of II 89 μ, the rest 79—86 μ, needles 72—75 μ, hairs 92—102 μ.

The vascular system may show a slight aberration from Piguet's description: the dorsal end of the transverse vessels in I may join the corresponding vessels of II, instead of fusing independently with the dorsal vessel. The dorsal vessel is always situated ventrally, on the left side of the alimentary canal, behind VI.

As to the gonads see pp. 42, 44.

The spermathecal ampulla (Pl. XIII, figs. 3, 4), when fully expanded, is very long, up to 390 μ, beginning with a long, very narrow part, with one or two slight dilatations, and ending posteriorly, in the sperm-sac, in VIII, with a large bag (cf. Fig. 27 *E*, p. 251). The wall of the ampulla is thick, when less expanded, with a fairly strong muscular layer, and a thick epithelium, the inner ends of the cells projecting into the lumen (Pl. XIII, fig. 2). In the fully expanded condition this is the case only with the ventral (posterior) wall, the other walls being very thin. The spermathecal duct is fairly long, about 75 μ, 17 μ in diameter, with an inconspicuous lumen, and walls of very high, columnar cells.

The spermathecal setae are situated laterally to the pockets, projecting through their openings. The pockets (Pl. XIII, fig. 1) are about 30 μ deep, opening downwards at their lateral side. The wall is about 10 μ thick, consisting of slightly columnar cells. The pockets are thickly set with large glandular cells. The setae, 135—140 μ long, have the appearance described in 1939, with a slightly bent distal end, broad in one plane, thin in the other (Fig. 17 *C*, *D*). Occasionally a small, proximal tooth may be present (Pl. XII, fig. 2; Fig. 17 *B*).

The male funnels (Pl. XIII, fig. 3) are about 45 μ in diameter, facing backwards into the sperm-sac. — The vasa deferentia (Pl. XIII, figs. 4, 5; Fig. 27 *E*) are long, about 335 μ, and make a series of convolutions in the contracted animal. The part in front of septum 5/6 is narrow, about 10 μ wide, and thin-walled, the part behind is about 15 μ wide, with walls 5—6 μ thick; here the cells have a somewhat glandular appearance.

The atria are very large, when filled with sperm, height and diameter being about 120 μ, and 80 μ by 65 μ respectively, almost filling up the space of VI (Pl. XIII, fig. 5; Pl. XIV, fig. 1; Fig. 27 *E*). The epithelium of the atrial wall is composed of very large glandular cells with granular contents (cf. p. 50). The atria are set with a thick prostate layer. Often, though not always, the top-most part of the atrium, where the vas deferens joins, is narrow, looking as if it formed the last part of the vas deferens (Pl. XIII, fig. 5, Pl. XIV, fig. 1). As it has the same structure as the atrial wall, it obviously belongs morphologically to the latter. The ejaculatory ducts (Pl. XIII, fig. 5) are inconspicuous, especially when the atria are fully developed. They do not consist of columnar cells.

The female funnels are as usual very small, situated immediately in front of septum 6/7, at about $^1/_3$ of the body height.

For the structure of the clitellum round the male pores, and elsewhere see p. 47.

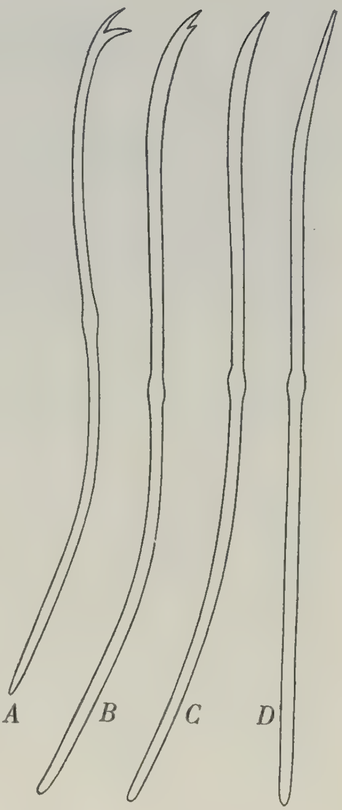

Fig. 17. *Piguetiella blanci.* *A* dorsal seta, *B-D* spermathecal setae, *B* with persisting proximal tooth, *C* simple, *D* either viewed in another plane. *A* 1200 ×, *B-D* 750 ×.

Genus **Haemonais** Bretscher, 1900.

Generic type: *Haemonais waldvogeli* Bretscher.

No eyes. Dorsal setae originally from II or VI, hairs and stout, double-pronged crotchets; after separation on budding shed in a number of anterior segments in the posterior zooid; ventral setae in a number of anterior segments differing in shape from the posterior ones. No distinct stomachal dilatation. Chloragogen present in all segments. Vascular system complicated, with an anterior net-work and transverse loops in all other segments, giving rise to longitudinal and transverse vessels along the inner side of the body-wall; dorsal vessel situated to the left. Coelomocytes present. Clitellum absent between male pores; vasa deferentia entering atria at upper part of anterior wall; no prostate; penial setae present.

Haemonais waldvogeli Bretscher, 1900.

Figs. 18 *C*, 27 *B*.

Hämonais waldvogeli Bretscher, 1900, pp. 16—18, Pl. I, figs. 11—14.
Haemonais waldvogeli Bretscher. Piguet & Bretscher, 1913, p. 54. Lastočkin, 1924 a, pp. 16—18. Malevich, 1929, pp. 48—49, Fig. 1. Ude, 1929, p. 51.
Haemonais laurentii Stephenson, 1915 a, pp. 769—781, Figs. 1—5, Pl. LXXIX.
[*?*] *Haemonais ciliata* Hayden, 1922, p. 169.
Haemonais laurentii Stephenson. Stephenson, 1923, pp. 79—80, Fig. 27.
[*? non*] *Haemonais laurentii* Stephenson. Chen, 1940, pp. 41—42, Fig. 9.

Dorsal setal bundles originally beginning in VI (or II ?), later shed in a number of anterior segments (usually those in front of XVIII—XX), containing as a rule 1 short hair, and 1 curved needle seta, with distal nodulus and long teeth, the distal tooth longer; or occasionally absent; ventral setae 2—4 per bundle, in anterior 15 or 17 segments slightly longer and thinner, with nodulus proximal, and distal tooth slightly longer than proximal; in posterior segments setae more curved, with distal nodulus, and distal prong shorter and much thinner than proximal, or occasionally absent. Pharynx in II—IV, with pharyngeal glands, oesophagus in V—XII, no discernible stomachal dilatation. Chloragogen present throughout the alimentary canal. Coelomocytes present. Clitellum in $^1/_2$ VI—$^1/_2$ VIII; spermathecal ampulla ovoid, with thick, irregular epithelium, some cells hanging into the lumen, duct short; male funnels cup-shaped; vasa deferentia short, wide, entering atria towards their upper surface; atrial ampulla small, ovoid, with thick, glandular epithelium, duct short; penial setae 1—3 per bundle, with distal nodulus, and distal end bifid, strongly curved. $n = 31—36$. $s = 40—60$. $l = 5—20$ mm. No swimming.

Europe, India.

It seems certain that *Haemonais laurentii* Stephenson is identical with the present species. The shape of the setae seems too be quite the same (compare Fig. 18 *C*, p. 159 with Stephenson, 1915 a, Fig. 1 a, b, d), only one prong, according to Stephenson probably the distal, may sometimes be absent in the needles of his specimens; and the dorsal setae begin in the same segments (XVIII—XX). The posterior type of ventral setae begins in XVI in the Indian specimens, in XVIII in the European (Russian) ones, but this difference seems of little significance. The length of the setae agrees well: according to Lastočkin and Malevich the anterior ventral setae are 103—117 μ, the posterior 96—108 μ, the needles 103—115 μ (the longer measurements hindmost), the hairs 132—160 μ; according to Stephenson, anterior ventral setae 80—104 μ, posterior 80—96 μ, needles 105—115 μ (the longer measurements hindmost), hairs 150 μ. Stephenson (1915 a, p. 780) summarized the distinguishing characters as follows: 1. "the ventral setae of segment viii are not here thicker than those of other segments as Bretscher found them in his species" — Lastočkin (1924), however, remarks that he found no difference; 2. "the shaft of the dorsal setae is considerably less curved than in *H. waldvogeli*, and the prongs are here markedly unequal in length (contrast with BRETSCHER's fig. 12)" — this is apparently due to the inexactness of B.'s figure (cf. Fig. 18 *C*); 3. "the greater size (up to 20 mm) of the present species (*H. waldvogeli* 5—12 mm)" — less important in S.'s opinion, too; 4. "the fact that the ventral setae may be as many as four per bundle (*H. waldvogeli* 2—3 per bundle)" — cf. MALEVICH (1929) who gives 2—4; 5. "the difference in the position of the first nephridium (in *H. waldvogeli* in segment iv, ix, or x, in the present species in vii)" — MALEVICH found the first nephridium in IX, so the character certainly varies, as is quite usual. BRETSCHER's statement about IV is probably a misprint.

In all other known characters, alimentary canal, vascular system, etc. the forms seem to agree. — The vascular system was thoroughly described and figured by BRETSCHER (1900), the sexual organs by STEPHENSON (1915 a; cf. Fig. 27 *B*, p. 251).

Possibly *Haemonais ciliata* Hayden (1922), belongs here, too. It has dorsal setae from XIV—XXII onwards, hairs 160 μ long, needles 110 μ, ventral setae 3 per bundle, 90 μ long, pharynx "pigmented at both ends," $n = 40$, $s = 55$, $l = 16$ mm. The vascular system, however, is stated to be "more like the usual naid type than that of *H. waldvogeli*," having contractile loops in most of the segments IV—XX. The statement that the body surface of a number of anterior segments is ciliated seems cryptic.

It seems very doubtful if *Haemonais laurentii* Stephenson of CHEN (1940) really is identical with STEPHENSON's form. It has dorsal setae from II, the hairs dropping out from the anterior 10 segments, but the needles persisting. The needles are 100 μ long, with a very weak nodulus and very long teeth (distal 10 μ) otherwise not aberrant, the ventral setae, 2—4 per bundle, are all only about 70 μ long, with distal nodulus, those of the posterior segments being slenderer than the preceding, in contrast with *H. waldvogeli*, where they are stouter. Other characters are stated to agree with the Indian form. It seems most probable that it is a new species, considering the differences in the setal characters.

Genus **Branchiodrilus** Michaelsen, 1900.

Generic type: *Branchiodrilus semperi* (Bourne).

No eyes. Transverse pigment stripes on anterior segments. Branchial processes from VI onwards on a number of segments, enclosing dorsal setae. Dorsal setae beginning in VI, hairs, and except in a number of anterior segments, straight or curved, simple-pointed needles. Ventral setae all alike, or changing type backwards. No stomachal dilatation. Vascular system in I—V forming a plexus; in all other segments one pair of transverse loops, in the gill-bearing segments each giving off a branch into a gill, and other branches to the body-wall; dorsal vessel situated ventrally. Coelomocytes present. Clitellum absent between the male pores; vasa deferentia entering atria towards their upper surface; no prostate; atrial duct surrounded by gland cells; penial setae present. Budding incomplete; 5 segments normally formed at anterior end.

Branchiodrilus semperi (Bourne, 1890).

Chaetobranchus semperi Bourne, 1890, pp. 83—89, Pl. XII.
Chaetobranchus semperi Bourne. Bourne, 1891, p. 355. Beddard, 1895, p. 302.
Branchiodrilus semperi (Bourne). Michaelsen, 1900, p. 24. Stephenson, 1912, pp. 228—229; 1923, p. 75.
Branchiodrilus menoni Stephenson, 1912, pp. 219—229, Figs. 1—3, Pl. XI.
Branchiodrilus menoni Stephenson. Stephenson, 1921, p. 752; 1923, p. 76, Fig. 25; 1925 a, p. 882. Aiyer, 1925, p. 31.

Gills only on about the anterior half of the body. Dorsal setal bundles with 1—3 hairs and 1—3 needles, straight in anterior segments, curved distally in posterior segments; ventral setae 2—6 per bundle; in a varying number of anterior segments thinner and with longer teeth than the rest, with nodulus median or proximal, and distal tooth $1^1/_2$ times as long as proximal; in posterior segments nodulus distal, and prongs approximately equally long. In the first 12—30 segments hair setae very fine, enclosed within the gills, in posterior segments thicker, projecting freely, or some setae enclosed in gills in the rest of the gill-bearing segments. $n = 87$. $s = 77$—200. $l = 8$—50 mm. No swimming.

S. Asia (India).

It seems fairly certain that *Branchiodrilus menoni* Stephenson, is identical with *Br. semperi*. There are some differences in the descriptions. Thus, the setae are more numerous in the latter form (hairs and needles 2—3 per bundle against 1—2, ventral setae 4—6 per bundle against 2—4), and the posterior ventral setae are figured by Bourne with shorter distal prong. This feature may, however, very well be due to inexactness in the drawing. Otherwise the setal characters agree very well, the needles passing from an anterior, straight form to a posterior, curved (whether the statement by both authors that needles are wholly absent in a number of anterior segments, is really true, remains to be found out), and the ventral setae likewise showing two forms. Bourne, however, states that the dorsal setae begin in II, whereas Stephenson found them from II—VI onwards. He explains this by referring to the incomplete mode of budding — no new seta-bearing segments are differentiated before separation, although a zone of fission is formed, and also gills and pigment stripes. As the formation of the lacking segments after separation is apparently a very slow process, most specimens are found with only an incomplete number of new segments, or often none at all; S. suggests that in some cases the formation of these segments is wholly inhibited. This would explain why Bourne found the dorsal setae from II; or perhaps he over-looked the small, newly-formed setae if there were any in some specimens. Stephenson does not consider this probable; when it is considered, however, that one of the localities for *Br. menoni* was the same as for *Br. semperi* (Madras), and that the former has been recorded several times from different places, whereas the latter has not been reported a single time since its description, it seems improbable that they are not the same species.

According to STEPHENSON the length of the hair setae in the segments where they project freely is about 330 μ (the gills are up to 720 μ long, but the setae here could not be measured); the needles are about 100 μ, the ventral setae of the "anterior type" behind V are 100—116 μ, the "posterior type" 110—139 μ, whereas the ventral setae of the prebranchial region are only 77—87 μ long, and much slenderer than the rest, though in type resembling those in the immediately following segments.

Branchiodrilus hortensis (Stephenson, 1910).

Fig. 28 *A*.

Lahoria hortensis STEPHENSON, 1910 a, pp. 59—66, Figs. 1—3, Pl. VIII.
Branchiodrilus hortensis (Stephenson). STEPHENSON, 1912, p. 229; 1923, pp. 77—78, Fig. 26. MEHRA, 1920, pp. 463—465, Figs. 1 B, 3. CHEN, 1940, pp. 65—67, Fig. 21.
Branchiodrilus hortensis (Stephenson) var. *japonicus* YAMAGUCHI, 1938, pp. 530—533, Figs. 1—2, Pl. XIX.

Gills present on nearly all segments from VI onwards. Dorsal setae 2—5 per bundle, on anterior part of body enclosed within the gills, on posterior part usually one hair projecting freely; in these segments also needles, 1—2 per bundle, with straight tip; ventral setae all of one type with distal nodulus and teeth equally long, the distal being thinner. Clitellum in V—VIII; spermathecal ampulla large, duct fairly long, narrow, well-defined; male funnels large, reaching back into the sperm-sac behind the atria; vasa deferentia long, strongly curved, entering atria near upper surface; atrial ampulla large, pear-shaped, duct narrow, well-defined, opening into a depression in the body wall; penial setae 2—3 per bundle, with a simple, distal hook. $n = 29—70$. $s = 35—120$. $l =$ up to 50 mm. No swimming.

E. and S. Asia.

Branchiodrilus hortensis var. *japonicus* Yamaguchi (1938) does not seem to merit an especial name. YAMAGUCHI separates it from the Indian form because of its greater length (20—47 mm against 16—25 mm), greater number of segments (80—150 against 90—120), and greater number of hair setae per bundle (4—5 against 2). CHEN's form from China, however, with a length of up to 50 mm, has $s = 35—58$, and 2—5 hair setae per bundle; thus the species seems to vary considerably in these respects.

The length of the longest hair setae according to STEPHENSON and YAMAGUCHI may attain about 1 500 μ, decreasing considerably backwards.

The needles are 120—200 μ long, the ventral setae 130—230 μ, the penial setae (according to MEHRA) 132 μ long.

The sexual organs were described by MEHRA (1920; cf. Fig. 28 *A*, p. 253), and CHEN (1940).

Genus **Dero** Oken, 1815.

Generic type: *Dero digitata* (Müller).

No eyes. Dorsal setae from IV, V, or VI onwards, hairs and double-pronged, pectinate or palmate needles; ventral setae of II—V usually of a shape different from those of the rest, with distal tooth longer than proximal, and equally thick, compared with equally long or shorter, and thinner, in the latter. Pharynx in II—IV, with pharyngeal glands; often septal glands; stomachal dilatation slow, beginning in VIII, IX, or X, or inconspicuous. Anus opening into a ciliated branchial fossa, usually containing gills; angles of posterior border of the fossa in one subgenus projecting as palps. A pharyngeal vascular plexus; contractile transverse vessels in a number of segments from VI onwards; dorsal vessel situated ventrally to the left; blood reddish. Coelomocytes present or absent. Nephridia often invested with bladder-like peritoneal cells. Clitellum absent between male pores; vasa deferentia joining atria anteriorly or on top; usually no prostate gland cells; ejaculatory duct surrounded by gland cells; penial setae present or absent. Asexual reproduction by budding or fragmentation. Usually living in tubes of secreted mucus and foreign matter.

This genus has been subject to confusion from the beginning, owing to the descriptions frequently having been made with consideration paid only to the shape of the branchial apparatus, which is extremely variable within the species. The attempt made by BOUSFIELD (1887) to revise the genus only made things worse. MICHAELSEN (1903 b) recognized this, and even suspected all European species without palps as belonging in reality to *Dero digitata* (Müller). Nevertheless he continued in the old paths. In the present paper I have tried to revise the genus under consideration of as many features as possible.

Formerly all species concerned were referred to *Dero*, but later those with palps have usually been separated as the genus *Aulophorus*, though the parallelism between the two genera has often been stressed (e. g. by SCHUSTER, 1915, STEPHENSON, 1931 a, MICHAELSEN, 1933). In fact, there seems to be no other non-failing difference between the two genera than the palps, and distinct projections resembling short palps are in fact found in *Dero* (*D. dorsalis*). The variation in the situation of the first dorsal setae, and the occurrence of several types of needles in different species show parallelism in both genera; the reproductive organs are very similar, and tube-construction prevails in both. In fact, the difference between different species of *Aulophorus* (e. g. *A. superterrenus* and a species of the *tonkinensis* type), and of *Dero* (e. g. *D. evelinae* and the rest) may, as far as known, be far greater than between species of the different genera (e. g. *Dero palmata* and *Aulophorus flabelliger*; cf. Fig. 18 *A* and *B*).

Three species of late usually referred to *Dero*, *D. malayana* (Stephenson), *D. bauchiensis* (Stephenson), and *D. lutzi* (Michaelsen) differ considerably more from the bulk of *Dero* than do most species of *Aulophorus*. They have dorsal setae beginning in IV (not stated about *D. lutzi*), and ventral setae all approximately equal; their asexual reproduction consists in fragmentation. *D. malayana* has a branchial, ciliated fossa without real gills, *D. lutzi* and *bauchiensis* are parasitic without gills, the former yet developing such, when cultured free-living. It is not certain that the three species really form a group, but the similarities are great, and as long as not more is known, nothing speaks against it. As it seems repulsive to unite these three species with *Dero*, and yet keep *Aulophorus* apart, I have made them one subgenus of *Dero*, and *Aulophorus* another, for it is certain that all these form one group among the Naids. One might have made a subfamily of the forms belonging here (Czerniavsky, 1880, separated them as the family *Branchinaididae*; cf. p. 244), and separate genera of the subgenera in question. These might in turn be divided into subgenera, e. g. *Dero evelinae* might form one under *Dero*, and *Aulophorus superterrenus* one under *Aulophorus*, and among the rest of the latter, those with dorsal setae beginning in V might form one group, the others another.

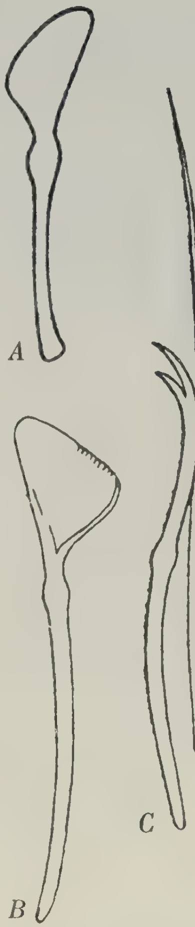

Fig. 18. *A Dero palmata*. Palmate needle seta (from Aiyer, 1930). *B Aulophorus flabelliger*. Palmate needle seta (from Stephenson, 1931 b). *C Haemonais waldvogeli*. Needle seta and hair seta (from Malevich, 1929.

The genus *Dero* is incomparably more richly represented in the tropics than in other regions; the subgenus *Allodero* is exclusively tropical. Its members are usually fairly large, about 10—20 mm long; very large species, up to 30, or even 60 mm, are not uncommon. Small species, 2—3 mm long, are uncommon.

It should be stressed that though the shape of the gills varies within the species, so that e. g., a not too great difference in length, cannot be used as a specific character, yet there is a distinct difference between finger-shaped or cylindrical, and leaf-like gills. — As to the place of the gills, those projecting from the bottom of the branchial fossa are here called ventral, those projecting from the lateral walls, and the roof of the foremost part of the fossa surrounding the anus, are called lateral and dorsal gills, respectively. — About the question of "primary" and "secondary" gills see p. 168, foot-note.

Subgenus **Allodero** subgen. nov.

Subgeneric type: *Allodero malayana* (Stephenson).

Dorsal setae beginning in IV, hairs and double-pronged needles; ventral setae all of one shape. A branchial fossa present (absent in parasitic specimens), with or without gills. No palps. Parasitism occurring. Asexual reproduction by fragmentation.

Allodero malayana (Stephenson, 1931).

Nais malayana Stephenson, 1931 a, pp. 266—269, 283—285, Figs. 1—2.
Dero malayana (Stephenson). Michaelsen, 1933, p. 334. Černosvitov, 1938 b, p. 274.

Dorsal setal bundles with 1—2 hairs, and 1—2 needles, bifid, with short teeth, and nodulus $^1/_4$ from distal end; ventral setae 3—4 per bundle, all alike, with nodulus slightly distal, and distal tooth slightly longer than proximal. Pharyngeal gland cells very long; "septal glands" present; anus dorsal, forming a ciliated fossa, without gills, but with a median ciliated projection from the bottom. $s = 37—73$. l (preserved) = 3—5 mm.

S.—E. Asia (Malacca).

The ventral setae are stated to be 50—67 μ long, the needles 59—61 μ, the hairs about 250 μ.

The "septal glands" of this species seem to represent rather an intermediate stage between real septal glands and oesophageal glands, having no relation to the septa, and being present in II—VI, forming definite aggregates in V and VI only (cf. p. 20). — Stephenson remarks that the shortness of segments II—IV suggests regeneration of 4 instead of 5 anterior segments; the statement that the cloragogen begins in VI, however, seems to make the usual number more probable.

Allodero bauchiensis (Stephenson, 1930).

Nais bauchiensis Stephenson, 1930 a, pp. 367—377, Figs. 1—2.
Nais bauchiensis Stephenson. Stephenson, 1931 a, pp. 283—285.
Dero bauchiensis (Stephenson). Michaelsen, 1933, p. 334.

Dorsal setal bundles containing 1—2 hairs, and 1—2 needles, bifid, with short, equally long teeth, and nodulus $^1/_5$ from the distal end; ventral setae 4—7 per bundle, in some anterior segments with nodulus median, and teeth equally long; posteriorly nodulus distal, and distal tooth equal to, or shorter than proximal; transition gradual. Alimentary canal degenerate; no septal glands; no branchial fossa. Dorsal vessel ventrally to the left; vessels on the inner surface of the body-wall in posterior segments. $s = 26—93$. $l = 3.5—11$ mm.

Africa. Parasitic on eyes and in Harderian glands of frogs (genus *Phrynomerus*).

The hairs are stated to be 210—280 μ long, the needles 46—52 μ, the ventral setae 53—65 μ.

Nothing is mentioned about septal glands, so presumably there are none. Neither are coelomocytes mentioned; the coelom was full of degenerate matter, so they will obviously not have been discernible, if present.

Stephenson suggests that the parasitic life may not be normal in this species which would be free-living in parts of Africa, only accidentally entering certain frogs. Here the alimentary canal would no longer be needed, and consequently would degenerate, in analogy with the conditions in *A. lutzi*. Some sort of branchial fossa might also then presumably be present in the free-living condition.

Allodero lutzi (Michaelsen, 1926).

Schmardaella lutzi Michaelsen, 1926 d, pp. 100—103, Fig. C.
Schmardaella lutzi Michaelsen. Lutz, 1927, pp. 485—486.
"*Schmardaella*" *lutzi* Michaelsen. Stephenson, 1931 a, pp. 284—285.
Dero lutzi (Michaelsen). Michaelsen, 1933, p. 334.

Dorsal setae usually absent, present only in the free-living state, 1 hair and 1 double-pronged needle per bundle; ventral setae 3—4 per bundle, all alike, with equally long teeth. Alimentary canal in parasitic specimens degenerate, with enormous chloragogen. Anal end unsegmented, swollen, richly vascularized, with a respiratory fossa with 4 pairs of digitate gills, under non-parasitic conditions; in parasitic conditions neither fossa nor gills. Dorsal vessel alternatingly to the right and the left; commissural vessels in all segments. $s = 34—60$. l (preserved) = 7—7.5 mm.

S. America; parasitic in ureters of frogs (*Hyla*).

The ventral setae are stated to be 85 μ long, 2 μ thick.

This species is very insufficiently known. The original, parasitic specimens of Michaelsen had no dorsal setae, and M. referred the species to the *Tubificidae*, close to *Aulodrilus*, on account of its "Analkieme" (the hindmost, swollen, blood-filled, unsegmented part of the body). When cultured free-living, however, the worms propagated asexually by fragmentation, and their offspring developed dorsal setae (Lutz, 1927; Stephenson, 1931 a); nothing is stated, however, about the segment in which they begin. They also developed a respiratory fossa, with 4 pairs of long gills. A normal alimentary canal, too, developed, and the chloragogen was reduced to normal proportions. Gland cells were present round the pharynx (and oesophagus?), but septal glands are not mentioned.

It seems possible that the species may normally be free-living, only occasionally entering frogs and becoming parasitic, as was suggested by Michaelsen (and by Stephenson for *A. bauchiensis*).

*

It is hardly possible to suggest anything about the relationships of the species of this subgenus, all being far too little known. *A. malayana* represents a primitive stage, as it has no real gills. The presence of gills in the free-living state in *A. lutzi* suggests a closer relationship to *Dero s. str.*, but on the other hand the statements that there are commissural vessels in all segments (LUTZ, 1927), and that the dorsal vessel runs alternatingly to the right and the left of the gut (MICHAELSEN, 1926 d), suggest more distant relations to that subgenus. The vascular system in the other species of *Allodero* is imperfectly known.

The subgenus seems to represent in several respects a fairly primitive stage of the genus, with uniform ventral setae, needles without complications, and, partly, not fully differentiated gills and septal glands.

Subgenus **Dero**, Oken, 1815.

Subgeneric type: *Dero digitata* (Müller).

Dorsal setae from IV, or VI; ventral setae of II—V as a rule sharply differentiated from those following. Stomachal dilatation present. No palps. No coelomocytes. Prostate gland cells sometimes present on atria; as a rule no penial setae. Budding present. Usually in fixed tubes.

Dero dorsalis Ferronière, 1899.

[?] *Xantho decapoda* DUTROCHET, 1819, p. 155.
[?] *Nais decapoda* (Dutrochet). BLAINVILLE, 1825, p. 131.
[?] *Uronais decapoda* (Dutrochet). GERVAIS, 1838, p. 18.
[?] *Dero? decapoda* (Dutrochet). VAILLANT, 1890, pp. 386—387.
Dero dorsale FERRONIÈRE, 1899, pp. 255—257.
Dero tubicola POINTNER, 1911, pp. 274—277, Pl. XXVIII, figs. 4—5.
Dero tubicola Pointner. SCHUSTER, 1915, pp. 18—24, 67, Figs. 10—14. MALEVICH, 1929, pp. 47—48. UDE, 1929, pp. 36—37, Fig. 41.
Dero austrina STEPHENSON, 1925 a, pp. 882—884. Pl. I, fig. 1.
Dero austrina Stephenson. AIYER, 1930, pp. 34—36, Figs. 10—11. STEPHENSON, 1931 a, pp. 269—270. MICHAELSEN, 1933, p. 334. CHEN, 1940, pp. 57—60, Figs. 18—19.
Dero dorsalis Ferronière. MICHAELSEN, 1933, p. 334.

Dorsal setal bundles from IV on, 1 hair and 1 double-pronged needle, with distal tooth slightly longer than proximal; ventral setae of anterior segments with longer distal tooth, and nodulus slightly proximal or distal, posteriorly gradually changing, teeth becoming equally long, or distal tooth shorter, and nodulus slightly distal. Stomach beginning in IX, X, or XI. Septal glands present, in IV—V. Branchial fossa with two diverging processes from postero-lateral border, and normally 5 pairs of gills: 2 posterior, ventral foliate, 1 lateral foliate, and 2 anterior, dorsal, one of which is long, cylindrical. Dorsal vessel ventrally to the left; contractile loops in VI—XIV. Clitellum in V—VII; spermathecal ampulla small, pear-shaped, duct short, poorly defined; male funnels large, cup-shaped; vasa deferentia short, entering atria at upper part of anterior wall; atrial ampulla large, almost globular, thick-walled, duct fairly long, well-defined, opening into an invagination, and piercing an aggregation of gland cells, surrounded by muscles; no penial setae. $n = 18$—53. $s = 23$—150. $l = 10$—30 mm. Tube-living.

Europe, S. and E. Asia.

The branchial fossa of this species (under the name *D. tubicola*) was described rather differently by POINTNER and SCHUSTER. POINTNER (1911) described and figured it (op. cit., Pl. XXVIII, fig. 5) as hexagonal, the posterior border concave with the hind corners angular, and 4 pairs of gills, 3 foliate and 1 dorsal, finger-shaped, springing from the base of two "Wülste" on the "dorsale Lippe". SCHUSTER (1915, Fig. 12) figures these "Wülste" as long and ciliated, and states that the hind border is convex, and provided with two lateral processes, longer still than the dorsal "Wülste" and also ciliated, functioning as gills. This thus gives a picture of 6 pairs of gills, whereas, if the "Wülste" in POINTNER's figure are assumed to be in reality gills, not more than 5 pairs are present here. -- The ventral setae in II are stated by POINTNER to be 5 per bundle, in the rest 3—4, posteriorly 2—1 per bundle. In the anterior bundles the distal tooth is longer, this difference gradually decreasing and vanishing backwards. The dorsal setae agree with those of *Dero "incisa"* (cf. p. 175). — SCHUSTER gives a similar description and pictures (op. cit., Fig. 10 a, c); the ventral setae of II—V are longer than the rest, 135 μ in II, 126 μ in V, 102 μ in VI, gradually decreasing backwards; the needles are 85—89 μ long, with slightly longer distal tooth. MALEVICH (1929) gives measurements for a specimen from Russia which agree, though here the length of the ventral setae decreases gradually from the second segment backwards, without any conspicuous gap between those of V and VI, being 135 μ in II, 120 μ in V, and 115 μ in VI. He gives larger numbers than POINTNER, 6—7 anteriorly. The needles are 100—108 μ, except in IV and V, where they are only 77—78 μ; the hairs, too, are shorter in the budded segments.

Dero dorsalis Ferronière (1899) is no doubt the same species as this. The dorsal setae, from IV on are 1 hair and 1 finely bifid needle, the ventral setae 4—5, with long teeth in the anterior segments, posteriorly with distal tooth shorter and finer. The branchial fossa is described as follows: "Le pavillon pygidien possédait une lèvre inférieure pourvue de deux pointes obtuses et très courtes, ce que lui donnait un peu la forme d'un croissant. Il possédait 4 paires de branchies assez courtes, la paire antérieure portant, près de la base, une légère bifurcation qui formait comme le rudiment d'une 5e paire de branchies." This agrees with POINTNER's specimens, if the dorsal swellings are supposed to be gills (the rudimentary gills of FERRONIÈRE), and the posterior angles are somewhat longer. With SCHUSTER's specimens it agrees if the posterior processes of that form are really processes of the fossa, and not gills. As *Dero tubicola* seems to be fairly variable as to the branchial apparatus, there seems to be no reason whatever to suppose that *D. dorsalis* not does belong here, and *D. tubicola* will thus have to be called *D. dorsalis*. FERRONIÈRE gives the length 18 mm, POINTNER 20 mm.

Dero austrina Stephenson (1925 a), also seems to belong here; the dorsal setae begin in IV, the needles being 90 μ long, with the distal prong slightly longer, and the ventral setae of the anterior segments being 5—8 per bundle, 100—118 μ, with longer distal tooth, from V on 100 μ, the distal tooth gradually growing shorter. The gills are stated by STEPHENSON to be 4 pairs, one of which is dorsal and accessory, but AIYER (1930), says there are 5 pairs, the posterior ones foliate, the most anterior small and dorsal, the next long and cylindrical (op. cit., Figs. 10 a, b). This picture agrees very well with POINTNER's, and especially with FERRONIÈRE's description, so much the more so, as the posterior border of the fossa is stated to have two lateral projections. CHEN (1940) records *Dero austrina* from China, and gives an elucidating picture (op. cit., Fig. 19 A), showing the first pair of gills fusing with the dorsal border of the fossa, giving the appearance of projections from the latter. — The body-length given by AIYER is 10—18 mm, by CHEN 10—30 mm.

SCHUSTER and CHEN have also given accounts of the sexual organs. Their material was not wholly mature, no sperm being found in the spermathecae and atria. The spermathecae agree very well in both, being small sacs, with a narrow, poorly defined duct (cf. SCHUSTER, 1915, Fig. 11, and CHEN, 1940, Fig. 19 B). So do the funnels and vasa deferentia, opening high up on the thick-walled atria. The latter are ovoid. CHEN figures the atrial wall enormously thick, 35 μ. From the figure it appears to have an epithelium consisting of several layers, so it will present an immature stage, when atrial epithelia often appear like that in sections; atria with more than one epithelial layer are not found in the family. CHEN also reports scattered gland cells on the anterior side of the atria, but these may be enlarged but non-glandular peritoneal cells, which are often found in this place. The atrial duct, according to SCHUSTER, pierces a strong aggregation of gland cells, enclosing the penial setae, surrounded by a muscle layer, and connected with the dorsal body wall by muscle strands. This closely resembles the conditions in *D. digitata*, in which the duct opens into a pit, towards which the gland cells converge (cf. p. 174, Pl. XVII, fig. 5), only there are no penial setae in the latter, and the muscle layer round the glands is not so conspicuous. This does not seem to be the case in CHEN's specimens of *D. "austrina"* either, otherwise the conditions agree wholly with those described by SCHUSTER. Thus, the shape of the sexual organs confirms the view of the two species as one. The penial setae were not described by Schuster; according to Chen (op. cit., Fig. 18 a) they are 4—7 per bundle, 175 μ long, 7 μ thick, with a small, distal prong.

Xantho decapoda Dutrochet (1819) may well belong here. It has "la queue figurée en une sorte de triangle, dont la base, tournée en arrière, est échancrée dans son milieu; cette surface aplatie supporte dix appendices mobiles et charnus."

Dero digitata (Müller, 1773).

Figs. 19 *A—E*, 27 *A*; Pl. XIV, figs. 2—5, Pl. XV, XVI, XVII. Pl. XVIII, figs. 1—3, 6.

Die blinde Naide, Das Blumenthier Müller, 1771, pp. 90—102, Pl. V.
Nais digitata (*coeca*) Müller, 1773, pp. 22—23.
Nais digitata Müller. Müller, 1776, p. 219. Gmelin, 1788—1793, p. 3121. Modeer, 1798, pp. 133—135. Blainville, 1825, p. 131; 1828, p. 499. Tabl. enc. méth., 1827, p. 134, Pl. LIII, figs. 12—18.
Dero digitata (*coeca*) (Müller). Oken, 1815, p. 363.
Nais (*Dero*) *furcata, florifera*. Oken, 1815, p. 363.
Uronaïs digitata (Müller). Gervais, 1938, p. 18.
Proto digitata Oken. Ørsted, 1842, p. 133. Johnston, 1845, p. 69. Houghton, 1860, pp. 393—396, Figs. 1—2.
Dero digitata (Müller). Grube, 1851, p. 105. [*?*] Tauber, 1879, p. 75. Timm, 1883, p. 254. Štolč, 1885, pp. 310—340, Pl. I—II. Stieren, 1892, p. 122. Bretscher, 1896, p. 510. Michaelsen, 1900, p. 28; 1905 b, p. 307; 1909 a, p. 24, Figs. 38—39. Piguet & Bretscher, 1913, p. 42. Ude, 1929, p. 35, Figs. 38—39.
Dero limosa Leidy, 1852 b, pp. 226—227.
[*non*] *Dero digitata* (Müller). d'Udekem, 1855, p. 549; 1859, p. 19. Levinsen, 1884, p. 218. Vaillant, 1890, pp. 381—382, Pl. XXII, figs. 21, 22.
Dero limosa Leidy. Minor, 1863, p. 38. Leidy, 1880, pp. 422—423, Figs. 1—2. Bousfield, 1886 b, p. 1098; 1887, p. 105, Pl. V, figs. 11—16. Vaillant, 1890, pp. 385—386. Stieren, 1892, p. 122. Beddard, 1895, pp. 298—299. Michaelsen, 1900, p. 28; 1903 b, pp. 178—182; 1909 a, pp. 23—24, Figs. 35—36. Moore, 1905 a, p. 167. Galloway, 1911, p. 304. Pierantoni, 1911, p. 3. Stephenson, 1914, pp. 330—332, Fig. 6; 1915 b, p. 785; 1915 c, pp. 789—793, Pl. LXXX, figs. 1, 3; 1923, pp. 88—89. Schuster, 1915, pp. 16—17, 66, Fig. 7. Smith, 1918, p. 640. Mayhew, 1922, pp. 159—166, Pl. XVI. Malevich, 1927, p. 8. Wolf, 1928, p. 389. Ude, 1929, pp. 34—35, Figs. 38—39. Aiyer, 1930, pp. 33—34, Fig. 9. Kondô, 1936, p. 385, Pl. XXIV, fig. 13. Černosvitov, 1938 b, pp. 269—270, Figs. 1—2. Berg, 1938, pp. 46—49, Figs. 27—32. Chen, 1940, pp. 52—55, Fig. 15.
[*?*] *Dero philippinensis* Semper, 1877, p. 107.
[*?*] *Dero philippinensis* Semper. Bousfield, 1886 b, p. 1098. Vaillant, 1890, p. 386.
Dero acuta Bousfield, 1886 b, p. 1098.
[*?*] *Dero Mülleri* Bousfield, 1886 b, p. 1098.
Dero acuta Bousfield. Bousfield, 1887, p. 105.
[*?*] *Dero mülleri* Bousfield. Bousfield, 1887, p. 104, Pl. IV, figs. 9—10. Beddard, 1895, p. 298. Stieren, 1892, p. 122. Michaelsen, 1900, p. 28.
[*?*] *Dero intermedius* Cragin, 1887, p. 32.

Dero (*?*) *obtusa* d'Udekem. MICHAELSEN, 1903 b, p. 181.
Dero incisa MICHAELSEN, 1903 b, pp. 182—184, Fig. 3.
Dero incisa Michaelsen. MICHAELSEN, 1909 a, p. 24, Fig. 37. SCHUSTER, 1915, pp. 17—18, 67, Figs. 8—9. UDE, 1929, pp. 35—36, Fig. 40. STEPHENSON, 1932, pp. 234—236, Figs. 6, 7.
Dero michaelseni SVETLOV, 1924, pp. 195—197, Figs. 1—8.
Dero bonairiensis MICHAELSEN, 1933, pp. 336—338, Pl. I, figs. 3—6.
Dero kawamurai KONDÔ, 1936, pp. 385—386, Pl. XXIV, fig. 14.
[*?*] *Dero tanimotoi* KONDÔ, 1936, p. 386, Pl. XXIV, fig. 15.
Dero quadribranchiata ČERNOSVITOV, 1937 b, pp. 145—147, Figs. 25—30.

Dorsal setae from VI on, 1 hair and 1 needle, double-pronged, with distal tooth 1—2 times as long as the proximal; ventral setae in II—V, 3—6 per bundle, longer than the rest, with nodulus proximal, and distal tooth $1^1/_2$—2 times as long as proximal; those following, 2—5 per bundle, thicker and more curved, with distal nodulus, and distal tooth hardly longer than proximal. 3 pairs of septal glands, in IV—VI; stomach in IX—X or X—XI. Branchial fossa normally with 4 pairs of gills, 1 small, dorsal pair, and 3 ventral, foliate, sometimes one or more pairs lacking, or 1—3 pairs cleft, forming supernumerary gills. Contractile vascular loops in some or all of VI—XIII. Clitellum in V—VII; spermathecal ampulla globular, duct well-defined; vasa deferentia short, narrow, joining atria near the top; atrial ampulla when mature anteflected, duct well-defined; no penial setae. n = 12—34. s = 20—105. l = 6—32 mm. Swims with spiral movements. In mucous tubes.

Cosmopolitan.

Sweden: Waters in Småland and Närke (ALMSTEDT, 1946, *D. limosa*); Bondkroken (I. ARWIDSSON coll.); pond at Karlsborg, Fyrisån, ponds at Uppsala, Åkerö tjärn.

MÜLLER, who described this species (1771) as "*die blinde Naide mit gefingertem Schwanz*," states about the caudal end: "Es zertheilet sich in sechs lanzenförmige, platte Enden, zwey nemlich an jeder Seite und zwey am Ende; innerhalb der letztern bemerket man eine kleine Warze, die der Anfang eines neuen Endes zu seyn scheinet" (op. cit., p. 95). These "Warzen" obviously represent the first pair of gills, which are much smaller than the rest, as also transpires from his figure of the branchial apparatus (Fig. 19 *A*, p. 172). He mentions also that the ventral setae are 3 per bundle, the hairs l; l = 5 lines (= about 10 mm). n from the figure = 21. MÜLLER also figures and shortly describes "*das Blumenthier*", seen by him 3 years earlier, which he is not sure whether it has to be referred to the former or not. It had "acht lanzenförmigen Blumen- und vier tellerförmigen Kelchblättern." This animal will no doubt be the same, the "Kelchblätter" being part of the posterior gills, seen from the side (Fig. 19 *B*; cf. Pl. XVIII, fig. 5). In 1773 he mentions for "*Nais digitata, coeca*" only the three long pairs of branchiae: "Cauda apicae in sex lacinias subaequales, digitiformes, non granulatas dividitur." After this, a number of authors repeated the erroneous statement about 6 gills, and the species was also frequently confused with *Aulophorus furcatus* (cf. p. 191).

In 1885 STOLČ gave a good account of the species, with figures. He stated that the ventral setae in II—V were 4—6 per bundle, those following 3—4, with the distal tooth longer; hairs and needles 1 per bundle, the latter (probably erroneously) described and figured with the proximal tooth longer. There are four pairs of gills, 3 larger, ventral, and 1 smaller, dorsal (op. cit., Pl. I, figs. 3, 4, the latter reproduced by MICHAELSEN 1909 a, and UDE). He also describes the vascular system, the nervous system, the nephridia, etc. in great detail.

Later MICHAELSEN (1900, 1909 a), and after him PIGUET and BRETSCHER (1913), and UDE (1929), state that in the ventral bundles of II—V the distal prong of the setae is the longer one, in the posterior segments on the contrary the proximal one is longer. In the dorsal bundles only hair setae are mentioned. This is obviously due to a misinterpretation by MICHAELSEN of ŠTOLČ's fig. 1, which he reproduces in 1909 (without mentioning the source). In this are figured a ventral seta (ŠTOLČ made no distinction between the two sorts of ventral setae), a needle, and a hair. Obviously MICHAELSEN, not troubling to translate the Czech explanation and overlooking the French summary, has mistaken the needle for a posterior ventral seta (M. himself, 1903 a, p. 180, foot-note, has suspected this, but has not corrected the diagnosis in 1909). Besides these characters only the four pairs of gills, and the vascular plexus of the anterior segments are mentioned. — After ŠTOLČ, only BRETSCHER (1896) reports finds of *Dero digitata*, and he gives no particulars. Apparently MICHAELSEN's erroneous conception of the setae has resulted in nobody identifying any *Dero* with *D. digitata*.

In 1852 LEIDY described *Dero limosa*, stating: "Five anterior annuli without setae. Two rows of podal spines, 5 to 6 in each fasciculus anteriorly; 3 to 4 posteriorly; long sigmoid, bifurcate at extremity. Setae single in one row upon each side. Caudal annulation, expanded, truncated, furnished upon each side of the anal aperture with four unequal, compressed, oval, curved, contractile, vibrillated appendages." $l = 2—6$ lines (= 4—12.2 mm). Setal length (hairs) $^1/_{166}—^1/_{133}$ in (= about 150—185 μ). He adds: "At first sight there appears to be only three appendages each side of the anus, but closer examination proves the existence of a fourth, small and not so distinct." — In 1880 L. described the branchial apparatus as follows: "Caudal ring expanded into a broad, membraneous, funnel-like pavilion, opening in a slanting manner dorsally and supporting eight divergent rays; anterior pair of rays papilliform; the others digitiform and successively increasing in length to the last pair. The rays are capable of extension beyond and retraction within the border of the pavilion." He thus makes no distinction between different sorts of gills, nor hints that the first pair would be situated on the border, as later authors have stated. Fig. 19 *C* represents LEIDY's figure of the branchial apparatus, "rays not fully extended." As can be seen, not one character given separates this species from *D. digitata*, and L. himself remarks that it "appears to accord so closely with the European species, *Dero digitata* of OKEN, that better means of comparison may prove it to be the same." — STOLČ (1885) united the two, but no attention was given to this.

BOUSFIELD, in 1887, published a study on the genus *Dero*, with a number of new species. He rejected the name of *Dero digitata*, considering it impossible to identify MÜLLER's species, which he regarded as a mixture of at least three species. He united *D. philippinensis* Semper (cf. below) with *D. limosa*, and added the species *D. acuta*, which is stated to have: "Characters nearly as in *D. limosa*; but the branchiae much longer, obovate in form, vith pointed apices; length about 4 or 5 times the greatest breadth." Already STIEREN (1892) and BEDDARD (1895) had recognized it to be identical with *D.* "*limosa*". BOUSFIELD also gives a figure of the setae of *D.* "*limosa*", one ventral from II—V, one posterior, and two needles, one viewed from the side, and thus looking single-pointed (op. cit., Pl. V, fig. 16). He regards the branchial apparatus as having only two pairs of gills, the anterior pair being only "secondary branchiae[1]", situated on the "dorsal lip" of the fossa. The second pair of gills such as described by LEIDY he regards as being part of the border of the fossa (op. cit., Pl. V, figs. 11—12; pp. 101, 105).

STIEREN (1892) was of the opinion that *Nais digitata* Müller, could easily be identified from the figures with *Dero digitata*, as described by STOLČ. He also rejected the division into primary and secondary gills. BEDDARD (1895), on the other hand, followed BOUSFIELD. MICHAELSEN (1900, 1909 a) gave BOUSFIELD's description of *D. limosa*, but retained *D. digitata*, and so did UDE (1929).

VAILLANT (1890) did not know of BOUSFIELD's paper; he rejected the identification of *D. limosa* with *D. digitata*, on account of D'UDEKEM's description of the latter; this description, however, in fact represents *Aulophorus furcatus* (cf. p. 191).

A full description of *D. limosa* from India was given by STEPHENSON (1914, 1915 c). In the first paper he gives a figure of the branchial apparatus (op. cit., Fig. 6). He speaks of 4 pairs of gills, two of which are secondary, rising from the margin of the fossa. He points out that the posterior of these two pairs are really gills, not part of the margin of the fossa, as stated by BOUSFIELD, being vascularized, and having the same structure as the other gills: "all four show in their interior a regular series of star-shaped or spindle-shaped cells, stretching by means of their processes across the cavity of the gill-process." Other characters are: ventral setae 3—4 per bundle, those of II—V about 127 μ long, 2.5 μ thick, with distal tooth $1\,^{1}/_{2}$ times as long as proximal, nodulus proximal; those following more curved, on an average 70 μ long, 3 μ thick, with distal nodulus, and distal tooth only slightly longer than proximal. Needles 1 per bundle, somewhat curved distal of the nodulus, 66 μ long, with teeth small, about equal; hairs 1 per bundle, 190 μ long. Contractile vessels 4 pairs, in VII—X. s = 47—49. l = 6 mm. A description of the genital organs is given in 1915 c. The spermathecal ampulla (op. cit., Pl. LXXX, fig. 1) is large, roundish, with a well-defined duct. There are large, cup-shaped funnels, the vasa deferentia joining the atria near the top. The atrial ampulla is large and globular, and the duct is well-defined, and surrounded by gland cells.

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[1] BOUSFIELD invented the terms "primary" and "secondary" gills, which have since then haunted the literature, and have been conceived differently by different authors. In reality all gills are constructed alike, and situated within the fossa — the use of the terms only creates confusion. Sometimes the terms "true" and "accessory" gills, respectively, have instead been used.

Aiyer (1930) gives setal measurements from Indian specimens, showing a smaller difference in length between the ventral setae than those given by Stephenson: ventral setae of II—V, 95—108 μ long, the rest, 72—90 μ, needles 63—72 μ, hairs 175—220 μ. As to the branchial apparatus he divides his material into two groups, one with 3 pairs of "true" gills and 1 pair of secondary ones projecting from the margin of the fossa, the other with 4 pairs of true gills, the first pair projecting from a forward recess of the fossa (op. cit., Fig. 9).

Schuster (1915) gives a few particulars of *D. limosa* from Germany. He gives a figure (op. cit., Fig. 7 b) of the branchial fossa, which is often almost rectangular, but otherwise shaped as Bousfield described. He states the ventral setae to be about 90 μ long, not mentioning any difference in length between those of II—V and the rest; the distal tooth in the former is somewhat longer, in the latter thinner than the proximal. The needle setae are 78—87 μ long, have a longer distal tooth, and are stated to be more curved than the anterior ventral setae, a somewhat misleading statement (op. cit., Fig. 7 a).

Mayhew (1922) also gives a full account of the species from N. America. He remarks, like Stephenson that the "lateral portions of the lip" have the position and structure of gills, but nevertheless he does not call them gills (op. cit., Pl. XVI, figs. 9—12). The ventral setae are 2—5 per bundle, those of II—V, 120—160 μ long, with the nodulus proximal, and the distal teeth tooth longer, the rest, 80—100 μ long, with the nodulus distal, and the equally long; needles (op. cit., fig. 13) 1 per bundle, slightly curved, with longer distal prong. "Their distal portions are much stouter than figured by Michaelsen ('09) and by Bousfield ('87), and the tips of the teeth are not sharppointed but slightly rounded." The spermathecal ampulla (op. cit., Figs. 1—2) is round, and the duct is narrow and curved. The funnels are large, and obliquely cut. The vasa deferentia are short, and wide, opening in the anterior ventral wall of the atria; the atria are oblong, bent forwards at a right angle to the duct, which is short, opening into a slight invagination in the body-wall (op. cit., figs. 3—8). No penial setae are present. This description of the genital organs does not, apparently, wholly agree with that given by STEPHENSON. $s = 40—55$. l (simple, preserved) $= 5—10$ mm.

BERG (1938) has photographs of Danish specimens (op. cit., Figs. 27—29), plainly showing four pairs of gills, though in the description the second pair are mentioned as belonging to the margin of the fossa; BERG, however, remarks, that they are functionally gills. The first pair are referred to as secondary. He shows that the gills are foliate, heart-shaped in a side view.

CHEN (1940) records *D. limosa* from CHINA. He gives the following particulars: Ventral setae of II—V, 4—5 per bundle, 100—128 μ long, thinner than the rest; the latter, 3—4 per bundle, 70—120 μ long; needles mostly 1 per bundle, 56—72 μ long, distal prong twice as long and thick as proximal, and weakly curved; hairs 1 per bundle, 180—200 μ long. Gills 4 pairs (2 first pairs secondary), posterior pairs either foliate or deeply cleft so as to form two almost separate long lobes (op. cit., Fig. 15 A, B). Contractile vessels in VI—IX. $n = 20—29$. $s = 30—48$. l (simple) $= 5$ mm, (chains) 6—12 mm. CHEN has also examined American specimens from Philadelphia, from where they were described by LEIDY, and records a few distinctions between the latter form and the Chinese one: larger size ($l =$ up to 25 mm), distincter budding-zone ($n = 20—55$), more distinct and slightly more divergent prongs of the dorsal needles. He remarks that the European, Indian, and Philippine (*D. philippinensis* is considered as a synonym) forms seem to agree more closely with the Chinese in these respects. He also reports only "true" gills in both the forms examined by him; in the American form there is "a distinct pocket-like depression in which the first pair of gills arises while between them there is an unpaired process just behind the skin fold." — CHEN also makes an attempt at synonymy; he regards it as very probable that the earlier descriptions of *D. digitata* referred in fact to this species, but is of opinion that they are unidentifiable (MÜLLER's "*blinde Naide*" he curiously enough ranges with *Aulophorus furcatus*, probably influenced by BOUSFIELD).

KONDÔ (1936, Pl. XXIV, fig. 13) briefly mentions *D. limosa* from Japan; it seems to have fairly strong needle teeth.

I have studied a considerable number of specimens from a couple of localities in Sweden, especially with regard to the gills and internal anatomy, and will give an account of them. The ventral setae of II—V are straighter and thinner than the rest, with proximal nodulus, and the distal tooth $1\,{}^1/_2$—2 times as long as the proximal (Pl. XVIII, fig. 1). In the rest the nodulus is distal, and the distal tooth is only slightly longer, but thinner than the proximal (Pl. XVIII, fig. 2). The needles have the nodulus about ${}^2/_7$—${}^1/_3$ from the tip. The distal tooth is about $1\,{}^1/_2$ times as long as, and slightly thinner than the proximal (Pl. XVIII, fig. 3). Thus, their form fits in very well with that of the specimens of Bousfield and Stephenson (only the distal tooth of the needles is longer), Chen (only the distal prong of the needles is not so thick), and especially Mayhew. Setal measurements are given below.

Setal characters from 1 specimen:

	v. s. II	v. s. III	v. s. V	v. s. VI	v. s. post.	n. s.	h. s.
number	5	5	4	5	5	1	1
length	150–157	144–160	141–144	106–109	96–110	91–102	330–360
thickn.......	2.7–3	2.7–3	2.7–3	3.5–4.5	3.5–4.5	2.7–3	2.5–2.7
teeth	$\frac{15}{10}$	$\frac{14\text{–}15}{10}$	$\frac{13\text{–}14.5}{9\text{–}10}$	$\frac{7}{7}-\frac{11}{6.5}$	$\frac{8}{6.5}-\frac{8}{7.5}$	$\frac{3.5}{2.3}$	

Mean length of dorsal setae and longest ventral seta:

	v. s. II	v. s. VI	n. s.	h. s.
numb. of spec.	17	16	18	17
mean	148	117	98	309

The extreme lengths found were: ventral setae of II—V, 135—165 μ, the rest 86—123 μ, needles 85—121 μ, hairs 294—390 μ.

As can be seen, the measurements agree best with those found in the North American form.

The stomachal dilatation is situated in IX and X, or X and XI (cf. p. 22). There are 3 pairs of septal glands (cf. p. 19; Pl. XV, fig. 1), in IV—VI. — For details of the alimentary canal see the anatomical section.

There are 4 pairs of gills. In the preserved state the three posterior pairs are high, 3-edged ridges, with a free, posterior end. The first pair are small, attached to the dorsal wall of the pocket-like recess above the anus (Pl. XIV, figs. 2—4), mentioned by Leidy, Aiyer, and by Chen in the American specimens. As Chen observed it is quite clear that the gills arise from the wall of the fossa, not from the border, as the latter is not ciliated and has the structure of the common body-wall (Pl. XIV, fig. 5). When the fossa is expanded these gills are bent forwards, and the dorsal margin of the fossa is folded forwards to let them pass. Then it may look swollen, and the gills may be mistaken for projections from it. The second pair are posteriorly intimately associated with the

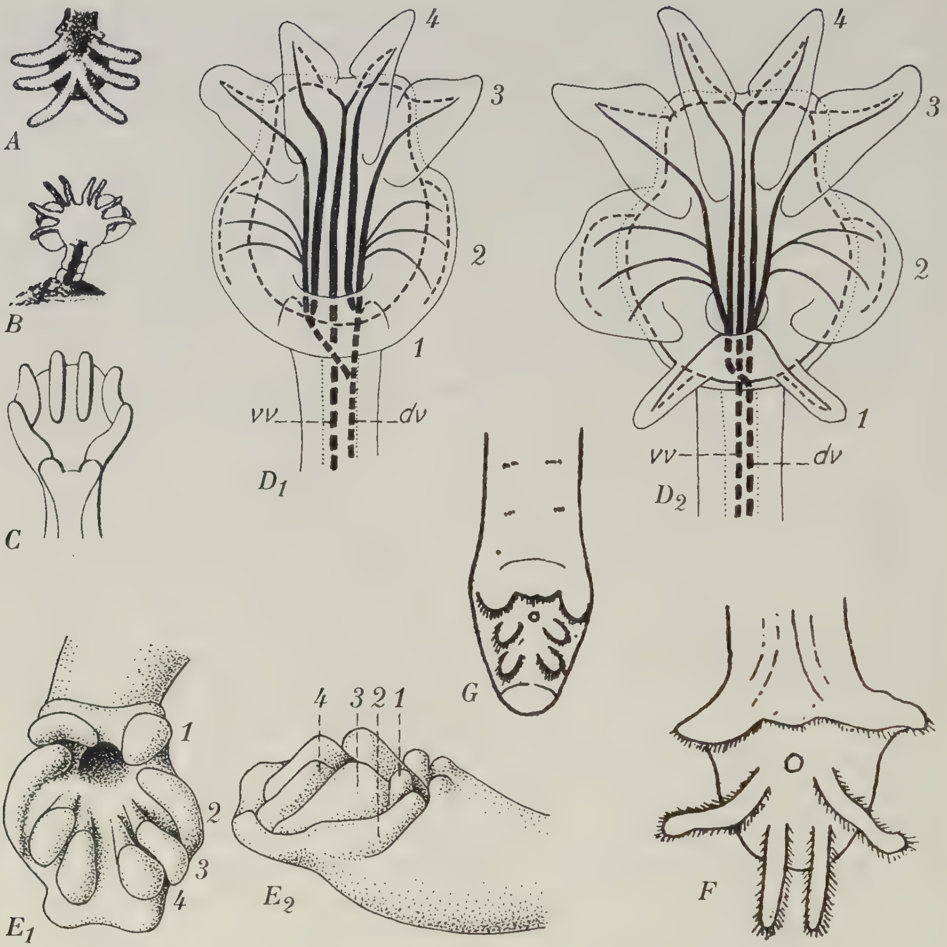

Fig. 19. *A-E Dero digitata.* Branchial apparatus. *A "Die blinde Naide", B "Das Blumenthier"* (from Müller, 1771). *C Dero "limosa"* (from Leidy, 1880). *D* Fully expanded, showing the vascularization, D_1 abnormal, D_2 normal specimen. *E "Incisa"*-form, preserved, E_1 from above, E_2 side view. *F Dero "perrieri", G D. "obtusa".* Branchial apparatus (from Chen, 1940). The figures indicate the order of the gills.

border of the fossa, and may be mistaken for part of it (cf. Pl. XIV, fig. 5). Anteriorly all the 3 last pairs end as low ridges, fusing with the wall of the fossa (Pl. XIV, figs. 3, 4; cf. Mayhew, 1922, fig. 16). All have the same structure, with a loose interior of stellate cells, and a surface consisting of a layer of club-shaped, ciliated cells (Pl. XIV, figs. 3—5).

The described arrangement is the common one, but a number of abnormalities are not infrequent. Thus, only one dorsal gill may be present, or a supernumerary ventral gill, or the dorsal pair, or a ventral pair may be wholly lacking. Usually only a few specimens present the aberration (this will have been the case with the *Dero* (?) *obtusa* in MICHAELSEN, 1903 a, too). — In one sample several specimens had the arrangement shown in Fig. 19 D_1, where the first two pairs of gills are fused, forming a continuous, everted brim (cf. below).

The vascularization of the branchial apparatus does not wholly conform with the description given by STOLČ (1885, Pl. I, fig. 20). Its arrangement is the following: the dorsal vessel branches in front of the anus (cf. Pl. XIV, fig. 2 *v*), and the two branches pass backwards, each giving off in turn one vessel to the first pair of gills (Fig. 19 D_2), 3 vessels to the second pair, and one vessel to each of the last pairs, all running along the median surface of the gills (the posterior in case of the first gills). They then pass through to the lateral (viz. anterior) surface, and run back along this, joining a marginal vessel round the border of the fossa, which in its turn joins the ventral vessel at the posterior end of the fossa. The three vessels to the second pair of gills seem all to join the one abducting vessel, though I could not find the points where this occurred. In the case where all the four anterior gills were united, the vessels still had their usual course (Fig. 19 D_1).

The form of the branchial fossa agrees most with the figure given by SCHUSTER (1915, Fig. 7 b), with the posterior border angular, suggestive of processes, but the part in front is much rounder in the expanded condition (Fig. 19 *D*, Pl. XVIII, fig. 6).

Contractile vascular loops are found in a varying number of segments, at the most in VI—XIII. The posterior ones are usually difficult to discern. — In the zone of growth a pair of vessels are found attached to the septum in each segment.

The canals of the nephridia are set with bladder-like peritoneal cells, described by STOLČ (Pl. I, fig. 21, žl) as "glandes cellulaires", and by PERRIER (1872, p. 86, Pl. I, fig. 3 u) in *D. obtusa*. They are quite transparent, almost globular, and do not look like usual gland cells. In sections their contents appear slightly granular, with large clear spaces.

The clitellum is present in V—VII. Contrary to the state in e. g. *Nais*, the clitellum begins foremost in V, being present in front of the spermathecal apertures, but absent around these. — The spermathecal ampulla (Pl. XVII, fig. 3) is roundish or longish, when filled with sperm very large, about 105 μ by 150 μ by 140 μ. The spermathecal duct is well-defined, 60 μ long, 20 μ in diameter, with walls about 9 μ thick.

The male funnels are very large, when fully developed (Pl. XVII, fig. 3). As MAYHEW described (op. cit., fig. 1), the dorsal wall is much shorter than the ventral; they are about 45 μ and 150 μ long respectively in one case, though at earlier stages this difference does not appear (Pl. XVII, fig. 2). The funnels are, as a rule, not directed backwards into the sperm sac, only dorsally, so that the oblique opening comes into contact with the walls of the narrow mouth of the sperm-sac. They are much flattened by the pressure of the spermathecae in the later stages, about 30 μ wide. Their walls are about 11 μ thick. — The vasa deferentia are relatively short, about 175 μ, and very narrow and thin-walled, except immediately behind the funnels, their diameter being 8—11 μ, with walls about 2.5 μ thick. They join the atria at the inner, anterior face, near to its proximal end (Pl. XVII, fig. 4). The atria, when young, are pear-shaped, not globular as those described by STEPHENSON (1915 c) in the Indian form. At a later stage the ampulla is bent, so that the top is directed forwards (Pl. XVII, fig. 4), reaching as far as septum 5/6, resembling the picture given by MAYHEW (1922, fig. 1). In this case the vas deferens makes one very abrupt curve, first directly downwards, then a short way backwards, before joining the atrium (Fig. 27 *A*, p. 251). In the most advanced stage the top of the atrium even points downwards (Pl. XVII, fig. 5). At the base the ampulla narrows gradually towards the duct. The whole length of the ampulla is then about 240 μ, the diameter about 100 μ, at a wall-thickness of 15—25 μ. The epithelial cells are large with reticular contents (cf. p. 50), and the muscular layer is strong. — The ejaculatory duct is short, about 60 μ long, with a diameter of 30 μ, and a wall-thickness of 13 μ. It opens on a clitellum-free space, which is invaginated to form a pit, about 35 μ deep (Pl. XVII, figs. 4—5). The duct is surrounded by long gland cells, which are, however, not attached to it, but to the wall of the pit. — Thus, in this more mature stage, the sexual organs wholly conform with MAYHEW's picture, except for the gland cells round the atrial duct, which he has obviously not observed.

Thus, it seems undeniable that the sexual organs are identical in the European and the American forms; judging from CHEN they seem to be so in the Chinese form, too. In the Indian form the atria seem to have a different shape, but otherwise this form agrees with the above-mentioned (the shape of the funnels being apparently variable, and easily over-looked).

As STEPHENSON (1915 c) pointed out, the alimentary canal degenerates during maturity, except in the hind part of the body, getting extremely densely set with chloragogen. The gills and branchial fossa may disappear completely.

n was = 12—34, s = 20—105 (mean value 56). l for simple animals was 8—20 mm, for chains, up to 32 mm.

The species swims with spiral movements, like *Nais barbata* for example.

A species usually united with *D. digitata* is *D. philippinensis* Semper (1877). It is stated to have dorsal setae from VI onwards and 4 pairs of gills, 3 large, foliate, and 1 shorter, conical. It is, however, only $1\,^1/_2$ lines (= 3 mm) long living, and is stated to live in small pieces of broken twigs, carrying them about. The statements about *D. digitata* (*limosa*) all agree that it lives in fixed tubes of mud, so the question had perhaps better be left open.

Dero Mülleri Bousfield (1886) is probably *D. digitata* with the dorsal gills absent. It is too big for *D. obtusa*, and the gills are foliate.

Dero intermedius Cragin (1887) is placed with an interrogation mark along with *D. limosa* by MICHAELSEN (1900), and by CHEN (1940). I have not had access to CRAGIN's paper.

Dero incisa Michaelsen (1903) seems to be only an occasional form of *D. digitata*. The setae, both in length and form, wholly agree with those of *D. digitata*. The following table shows M.'s measurements:

	v. s. III	v. s. XII	n. s.	h. s.
length	130	100	70	330
thickn.	3.5	6	3	
teeth	$\frac{12}{8}$	$\frac{6\text{–}7}{6\text{–}7}$		

SCHUSTER (1915) gives the following measurements: ventral setae in II—V, 124—132 μ long, the rest, 105—108 μ, needles 91—93 μ, hairs 260—275 μ (cf. op. cit., Fig. 8). — I, too, found this form on one occasion (Lake Åkerö tjärn), and measurements from one specimen are shown below:

	v. s. II	v. s. VI	n. s.	h. s.
length	126–144	108–111	96–108	240–295
thickn.	3–3.2	3.6–4.2	3	
teeth	$\frac{14\text{–}15}{8\text{–}10}$	$\frac{6.4\text{–}8}{6.4}$	$\frac{2.2}{1.7}$	

There are 4 pairs of gills, 2 posterior, foliate, 1 lateral, fusing with the border, and 1 anterior, small (the two latter pairs MICHAELSEN suspects to be possibly "secondary"). The posterior border of the fossa is drawn out into two lateral angles, quite as in *D. digitata* (MICHAELSEN, 1903 b, Fig. 3; cf. MICHAELSEN, 1909 a, Fig. 37; UDE, 1929, Fig. 40). SCHUSTER (op. cit., Fig. 9) found it to be, as a rule, roundish, while in my specimens it agreed wholly with Michaelsen's (Fig. 19 *E*). The only difference from the common form of *D. digitata* is an incision in the dorsal border, producing, in the preserved state at least, two small knobs (Fig. 19 E_2); the depth of the incision seems to vary (cf. the figures). It seems most likely that this is only an aberration, without taxonomical significance.

The specimens of *D. incisa* described by STEPHENSON (1932) from

Abyssinia seem to agree with the Indian form of *D. digitata.* They have no incision in the dorsal margin of the fossa, so there seems to be no motive for calling it "*incisa*". The branchial apparatus has exactly the shape common in the species, and the form of the setae agrees, too, only the teeth of the needles are very fine, as in the Indian and West-Indian (*D. bonairiensis*) forms. No measurements are given. It is supposed to propagate by fragmentation, no budding-zones being found, and many specimens being incompletely developed at the ends. $s = 61—102$. l (preserved) = 11—16 mm.

Dero michaelseni Svetlov (1924) from Russia is certainly identical with *D. digitata.* The form and number of the setae wholly conforms with this species (op. cit., Figs. 1—5). The ventral setae of II are on an average 150 μ long, those of VI, 106 μ, the needles 88—106 μ, the hairs about 282—318 μ (2.5—3.5 times the length of the needles). (The length of the ventral setae of III is given as 198 μ, but as those of II, and IV, are 150 μ, it will almost certainly be a misprint, probably for 148.) There are 3 pairs of "true" gills, and 1 pair of "accessory" ones (op. cit., Figs. 7, 8). Contractile vessels are figured in VI—IX. $s = 44—66$. l (simple) = 10—12 mm, (chains) = 20—25 mm. Thus, there are no differences whatsoever from *D. digitata.*

Dero bonairiensis Michaelsen (1933) from West-India seems to agree in all features, except in the needle teeth, which are much shorter, and about equally long (op. cit., Pl. I, fig. 5). Otherwise the setal characters given, ventral setae in II—V up to 120 μ long, 3 μ thick, with very long teeth, the distal longer, the rest 60—70 μ long, with teeth about equally long, needles and hairs about 1.6 μ thick (the figure given is 16 μ, but this is certainly a misprint, as they are stated to be very slender). If the length of the teeth of the anterior ventral seta, given in M.'s fig. 6, measured from the picture, is divided by the enlargement given, 1 480 ×, the result is about $\frac{33\ \mu}{23\ \mu}$ which is an enormous length. But then the thickness of the seta would be 7 μ, and it is given as 3 μ. The enlargement needed if the latter figure is true, would be about 3 400 ×, and in this case the length of the teeth is about $\frac{14\ \mu}{10\ \mu}$. This is so much the more probable, as the thickness of the needle with the enlargement given would be 3 μ, with that calculated here about 1.4 μ (given as 1.6 μ). The length of the needle teeth then is only about 0.9 μ. The measurements, and the shape of the needles show very good agreement with the Indian form of *D. digitata* (cf. p. 169). The branchial fossa has the usual arrangement of the gills (op. cit., Pl. I, figs. 3—4); its posterior margin is straight, though not angular. $s = 31—60$. l

(preserved) = 3—6 mm. No budding was observed. This form was found in oligohaline water, but so were a number of other limnic species.

Dero quadribranchiata Černosvitov (1937 b) from Argentine is a trifle more deviating. The setae agree very well: the ventral setae of II—V (op. cit., Fig. 25) are 140—160 μ long, with teeth $\frac{12\text{—}14\ \mu}{7\text{—}8\ \mu}$, the rest 105—115 μ, with teeth $\frac{8\text{—}9\ \mu}{6\text{—}7\ \mu}$, the needles 75 μ long, with small, equal teeth (op. cit., Fig. 27), the hairs 250—300 μ. Thus, the seta measurements agree well with the common form, whereas the form of the needles agrees with that of the Indian and West-Indian forms. The branchial apparatus seems to be somewhat aberrant, though this may be due to strong contraction (op. cit., Figs. 29—30). The lateral angles of the fossa are more accentuated than usual, and the fossa more closed. What seems more weighty is the statement that the gills are all *ventral*, the foremost pair, too. Č. writes: "Cette espèce presente le plus affinité avec *Dero digitata* — —. Il en differe par la forme des aiguilles dorsales présentant des dents égales tandis que chez *D. digitata* l'une d'entre elles est beaucoup plus longue que l'autre, par la forme des crochets ventraux à dent supérieure plus longue que l'inférieure (chez *D. digitata* on observe le contraire) ainsi que par la forme du cerveau." As to the second of these differences, it is due to an error of MICHAELSEN (cf. p. 167). The brain agrees very well with that of *D. digitata*; the form varies with the state of contraction.

The inclusion within *D. digitata* seems justified. — $s = 51$—67. $l = 8$—10 mm. No budding was mentioned.

Dero kawamurai Kondô (1936) and *Dero tanimotoi* Kondô (1936) both seem to belong to *D. digitata*. *D. kawamurai* is simply an *incisa*-form; KONDÔ states it to differ from *D. incisa* in the form of the hind border of the fossa, which is convex instead of excavated (op. cit., Pl. XXIV, fig. 14 a). This would in itself be a poor difference, and SCHUSTER found it to be usually convex in *D. incisa*. As to *D. tanimotoi*, it is stated to have 3 pairs of gills in the fossa and one pair of secondary branchiae from the ventral border (op. cit., fig. 15 a), directed forwards. Judging from the figure, these processes may as well be small projections of the border, and it may well present an abnormal form of *D. digitata*, along with which and *D.* "*kawamurai*" it was found living. However, the ventral setae are all stated to be equally long, so the identification is not quite certain. $s = 35$—45. $l = 15$—20 mm. Judging from the figures, which are, however, very primitive, and do not seem at all reliable, the ventral setae of II—V in *D. kawamurai* are about 135 μ long, the rest 108 μ, the needles 89 μ; in *D. tanimotoi* the corresponding figures are 103 μ, 96 μ, and 81 μ. In the latter the teeth of the needles are figured finer and shorter than in the former (op. cit., Pl. XXIV, figs. 14 b, 15 b).

*

If the different forms of *Dero digitata* are compared with one another, some general features will transpire. Thus, it is apparent that the European (incl. *D. incisa* and *michaelseni*) and North-American forms form a group, probably together with the Japanese (incl. *D. kawamurai*, and, possibly, *D. tanimotoi*), being large, with longer setae, the teeth of the needles being strong and unequal. Among these, the two latter forms deviate a little from the European in having the distal tooth of the needles twice as long and strong as the proximal, while in this it is about 1.5 times as long and a trifle thinner. The Chinese form in this respect resembles the American and Japanese, but the teeth are finer, and it is much smaller in size, with, on an average, smaller setae, in these respects forming a transition to the Indian form (incl. *D. philippinensis* ?), which has fine, equal teeth, and also a rounder atrium than the European and North American forms. With the Indian form the West-Indian *D. bonairiensis* apparently agrees. To this group possibly belongs the geographically intermediate form from Africa (*D. incisa*, Mich., of STEPHENSON, 1932), which is stated to have extremely fine teeth on the needles, though it is larger (about the specimens from Africa recorded by MICHAELSEN, 1905 b, and ČERNOSVITOV, 1938 b, no particulars are given) — Somewhat intermediate between the West-Indian and the North-American forms appears the South-American *D. quadribranchiata*, with size of setae and body agreeing with the latter, and needles with the former, and slightly deviating branchial arrangement. Thus, the species is apparently divided into a number of geographical races, but as yet our knowledge is too scanty to allow of the characterization and delimitation of specified races.

Dero zeylanica Stephenson, 1913.

Dero zeylanica STEPHENSON, 1913 a, pp. 252—256, Pl. I, figs. 1—4.
Dero zeylanica Stephenson. STEPHENSON, 1923, pp. 89—90, Fig. 33. AIYER, 1930, pp. 30—32, Fig. 8.

Dorsal setae from VI onwards, 1—4 hairs, and 1—4 needles, bifid, with very fine teeth, and nodulus slightly distal; ventral setae of II—V, 4—5 per bundle, longer than the rest, with nodulus median, and distal tooth twice as long as proximal, the rest 4—6 per bundle, with nodulus distal, and distal tooth slightly longer than, and $^1/_3$—$^1/_2$ as thick as proximal. Stomach in IX—X, X, or VIII—IX; no septal glands, but gland cell aggregations on the gut in IV and V, 4 pairs of foliate gills, 2 ventral, 1 lateral, and 1 dorsal; branchial fossa with a forward diverticulum above the anus. Dorsal vessel ventrally to the left; contractile loops in VI—IX. Brain widely indented in front, narrowly behind. Clitellum in $^1/_2$ V—$^1/_2$ VIII. Spermathecal ampulla long, club-shaped, often entering the sperm-sac, reaching through VI and VII, duct narrowing towards the opening; male funnels cup-shaped; vasa deferentia joining atria at their anterior face, slightly above the middle; atrial ampulla large, globular, thin-walled; atrial duct short, surrounded by peritoneal cells, opening into an invagination. n = 31—33. s = 42—60. l (simple) = up to 10 mm, (chains) = up to 14 mm. Swims with spiral movements. Usually not tube-dwelling.

S. India, Ceylon.

This species is obviously closely related to *D. digitata*; it especially resembles the Indian form of the latter. The gill arrangement agrees wholly with the latter (AIYER, 1930, Fig. 8), the shape of the setae is very slightly different, the ventral setae of II—V having the distal tooth 2 against 1 $^1/_2$ times as long as the proximal, and nodulus median. The number of dorsal setae, however, is much larger, generally 3 hairs and 3 needles in the anterior bundles, against almost invariably 1 of each in *D. digitata*. — The seta measurements are stated to be: ventrally in II—V, 114—128 μ, behind V, 85—95 μ, needles 82—102 μ, hairs 240—320 μ. — The absence of septal glands is a considerable difference from *D. digitata*.

As to the sexual organs, the shape of the spermathecae is different. I never found them entering the sperm-sac in *D. digitata*; they were always roundish, even when crammed with sperm at late stages, when a ripe ovum was present in the egg-sac. The male funnels in *D. zeylanica* do not seem to be obliquely cut, even in fully mature specimens, the vasa deferentia join the atria lower than in *D. digitata*, and the atria are erect and globular (AIYER, 1930, p. 32). There seems to be an ecological difference, too, *D. zeylanica* as a rule not living in tubes. AIYER (op. cit., p. 33) states about *D. limosa*: "The worm is smaller, more slender and less active than *D. zeylanica* and can be easily recognized by the pinkish tinge on its body wall."

Dero cooperi Stephenson, 1932.

Dero cooperi STEPHENSON, 1932, pp. 231—233, Figs. 2—5.

Dorsal setae from VI onwards, 1 hair and 1 needle per bundle, needles bifid, with teeth short, equal; ventral setae of II—V, 3—5 per bundle, longer than the rest, with nodulus median, and distal tooth 1.5 times as long as proximal; the rest 4 per bundle, with nodulus distal, and teeth much shorter, proximal prong thicker and slightly longer than distal. Branchial fossa with a spout-like posterior prolongation; anterior portion with 4 pairs of gills, the foremost dorsal, very small, the hindmost foliate, the second and third pair thicker; anterior pairs in the contracted condition hidden by the roof of the fossa; no diverticulum above anus. n = 22—24. s = 33—46. l (preserved) = 3.4—4.3 mm.

Abyssinia.

The setal length is stated to be: ventrally in II—V, 110 μ, with distal tooth 10 μ, in the rest 74 μ; needles 53, μ hairs up to 250 μ. The shape of the setae is not very different from that in the Indian form of *Dero digitata*, and their length, though small, lies within the range for this form. The shape of the branchial fossa is, however, so strikingly different, that they can hardly be the same species (STEPHENSON, 1932, Figs, 2, 3). Also, *D. cooperi* was found together with *D. digitata* ("*incisa*," probably, at least; cf. op. cit., p. 234, the account of localities). With the exception of the gills it also resembles *D. nivea*, which also has the branchial fossa prolonged backwards, though not at all so far.

Dero obtusa d'Udekem, 1855.

Figs. 19 *F*, 20 *A*; Pl. XVIII, fig. 5.

[*?*] *Xantho hexapoda* DUTROCHET, 1819, p. 155.
Dero obtusa D'UDEKEM, 1855, pp. 549—550, Pl., fig. 1.
Dero obtusa d'Udekem. D'UDEKEM, 1859, pp. 18—19. PERRIER, 1872, pp. 65—96, Pl. I. TAUBER, 1879, p. 75. VEJDOVSKY, 1883, p. 217; 1884, p. 27. LEVINSEN, 1884, p. 218. BOUSFIELD, 1886 b, p. 1098; 1887, p. 104, Pl. III, figs. 1—3. VAILLANT, 1890, p. 385, Pl. XXII, fig. 23. STIEREN, 1892, p. 122. BEDDARD, 1895, p. 300. MICHAELSEN, 1900, p. 28; 1909 a, p. 23, Fig. 34. GALLOWAY, 1911, p. 304. PIGUET & BRETSCHER, 1913, pp. 43—44. SCHUSTER, 1915, pp. 15—16, 66, Figs. 5—6. SMITH, 1918, p. 640. WOLF, 1928, pp. 390, 403. UDE, 1929, p. 34, Fig. 35. ČERNOSVITOV, 1942 a, pp. 202—206, Figs. 21—31. MARCUS, 1943, pp. 56, 57, Pl. IX, fig. 41, Pl. X, fig. 42; 1944, p. 67, Pl. XIII, fig. 57.
Dero latissima BOUSFIELD, 1886 b, p. 1098.
Dero perrieri BOUSFIELD, 1886 b, p. 1098.
Dero perrieri Bousfield. BOUSFIELD, 1887, p. 104, Pl. IV, figs. 4—7. STIEREN, 1892, p. 121. BEDDARD, 1889 b, pp. 440—444, Figs. 1—3; 1895, p. 299. MICHAELSEN, 1900, pp. 27—28; 1909 a, pp. 22—23, Figs. 32—33. PIGUET, 1906, pp. 274—278, Pl. X, fig. 21, Pl. XII, fig. 18. PIGUET & BRETSCHER, 1913, pp. 42—43. SMITH, 1918, p. 640. UDE, 1929, p. 37, Figs. 42—43. CHEN, 1940, p. 57, Fig. 17.
Dero latissima Bousfield. BOUSFIELD, 1887, p. 104, Pl. IV, fig. 8. STIEREN, 1892, p. 122. BEDDARD, 1895, pp. 300—301. MICHAELSEN, 1900, p. 27.
Dero communis GOLANSKI, 1911 (*fide* SZARSKI, 1936 b).
Dero polycardia HAYDEN, 1922, p. 168.
Dero communis Golanski. SZARSKI, 1936 b, pp. 388, 397.
[*? non*] *Dero obtusa* d'Udekem. CHEN, 1940, pp. 55—56, Fig. 16 A.

Dorsal setae from VI on, usually 1 hair, and 1 needle, finely bifid, with equal teeth, and with nodulus about $^1/_3$ from the tip; ventral setae of II—V, 2—4 per bundle, longer and thinner than the rest, with distal tooth twice as long as proximal, nodulus proximal; from VI on, 3—6 per bundle, with teeth about equally long, nodulus distal, stoutness and thickness of proximal prong gradually increasing, and length of distal prong gradually decreasing backwards. Stomach in IX—X, or X. Septal glands in IV—VI. Branchial fossa normally with 3 pairs of gills, 2 ventral digitate, and 1 lateral foliate, or 2 ventral, and 1 pair of dorsal ciliated swellings. Contractile loops in VI to VII, IX, or X. Clitellum in V—VII; spermathecal ampulla roundish or elongated, duct well-defined, swollen in the middle; vasa deferentia short, joining atria at anterior side; atrial ampulla large, globular, duct well-defined, dilated at the middle, surrounded by gland cells; no penial setae. $n = 18—29$. $s = 21—35$. $l =$ 5—17 mm. Swimming. Tube-dwelling.

Europe, Palestine, N. and S. America, China.

Sweden: Långsjön.

The confusion within this species has been considerable. It has always been recorded with two pairs of gills, although D'UDEKEM's fig. 1 shows quite clearly also one pair of lateral gills, in connection with the border of the fossa, like the second pair in *D. digitata* (cf. also BOUSFIELD, 1887, Pl. III, fig. 3). BOUSFIELD's picture (op. cit., Pl. III, fig. 2) shows this better still. There are two pairs of short ventral, cylindrical gills, and 1 pair of lateral, foliate gills. $l = {}^1/_2$—1 cm.

Dero obtusa was thoroughly described by PERRIER (1872). He describes 2 pairs of digitate gills, and the antero-lateral corners of the fossa as being broadly expanded and ciliated, suggesting 1 lateral pair of gills (op. cit., Pl. I, fig. 4). The gill nature of these expansions is further stressed by the vascularization; the dorsal vessel, which divides into branches, one for each gill, also gives off a branch into each of the lateral projections. BOUSFIELD separated PERRIER's form from D'UDEKEM's, and his figure of *D.* "*perrieri*" also shows 3 pairs of gills, one of which is lateral (op. cit., Pl. IV, fig. 6). The difference between the two species is stated to be a "dorsal lip" in *D. obtusa*, i. e. the anterior ends of the lateral gills fuse with the dorsal wall of the fossa a little way in front of the margin, whereas in *D.* "*perrieri*" it would join the margin. BOUSFIELD, and various other authors have, however, failed to see that the first pair of gills in e. g., *D. digitata*, join the wall of the fossa in front of the margin, etc., so the difference does not seem at all convincing.

PERRIER describes the ventral setae of II—V as being 4—6 per bundle, longer, straighter, and thinner than the rest, which are 4 per bundle. There is 1 hair, and 1 bifid needle per dorsal bundle. There is a stomachal dilatation in X, 5 contractile loops in VI—X, "salivary glands" (obviously = the septal glands) in VI and the preceding segments. $l = 13$ mm. $n = 18$. $s =$ about 25.

Later authors have referred their specimens quite arbitrarily to *D. obtusa* or *perrieri*. BEDDARD (1889 b) found the sexual organs of *D.* "*perrieri*". He gives a good picture of the spermatheca (op. cit., Fig. 3), with ovoid ampulla and well-defined duct, swollen at the middle.

PIGUET (1906) gives an account of *D.* "*perrieri*". He states the dorsal setae to be 1 hair, 98—171 μ long, and 1 bifid needle with short teeth, 62—72 μ long. The ventral setae are 3—4 per bundle, those of II—V 95—119 μ long, with longer distal tooth, the rest 72—82 μ long, abruptly or little by little getting subequal teeth (op. cit., Pl. XII, fig. 18). There is a stomach in IX, vascular loops in VI—IX. $n = 18$—19. $s = 35$. $l = 5$—7 mm. It is stated to swim with lateral mowements.

SCHUSTER (1915) reports *D.* "*obtusa*". The description of the setae wholly agrees with PIGUET's *D.* "*perrieri*" (cf. op. cit., Fig. 6). Length: ventral setae in II—V, 103—105 μ, the rest 81—82 μ, needles 67—69 μ, hairs 180—182 μ. He gives only a lateral view of the branchial fossa, stating that there are 2 pairs of gills, the anterior border, however "der seitlich vorspringend mehr mit der Beschreibung BOUSFIELD's als der D'UDEKEMS übereinstimmt," showing that there must be in reality 3 pairs. There are dilated transverse loops in VI—VIII. $n = 18$—29. $s = 24$—45. l (simple) = 6.5—12 mm, (chains) = up to 17 mm. There seems to be no reason whatever to assume a specific difference between SCHUSTER's and PIGUET's specimens, both being referable to *D. obtusa*, like the fore-going.

CHEN (1940) claims to have found both *D. obtusa* and *D. perrieri* in China. He recognizes the presence of 3 pairs of gills in the latter (Fig. 19 *F*, p. 172), and gives the following particulars: branchial fossa broader than body, $n = 18$, $s = 21$—35, $l = 6$ mm. He also gives a short description and figure (op. cit., Fig. 17) of the genital organs. The spermathecal ampulla is long, constricted at the middle, the duct well-defined, dilated at the middle. The male funnels seem to be large, obliquely cut, the vasa deferentia short, entering the atria below the middle of the anterior side. The atrial ampulla is large, globular (90 μ in diameter), the duct short, well-defined, dilated at the middle and surrounded by gland cells. This obviously represents *D. obtusa*. — As to his *D. obtusa* see p. 185.

MARCUS reports *D. obtusa* from Brazil. His seta measurements agree very well with those of PIGUET's, SCHUSTER's, and ČERNOSVITOV's forms, and my own (see below). They are (MARCUS, 1943, p. 56): ventral setae of II—V, 4—5 per bundle, 107 μ long, 2 μ thick; the rest 3—5 per bundle, 70 μ long, 3 μ thick; hair setae 140 μ long, needle setae 70 μ. Their shape also agrees (op. cit., Pl. IX, fig. 41). The stomach begins in VIII or IX. Transverse vessels are present in VI—VIII, and the branchial apparatus seems to be somewhat intermediate between the type with three pairs of gills, and the form with two pairs of gills and 1 pair of swellings (cf. below). MARCUS reports 2 pairs of gills, and a ciliated "dorsal lip" separated from the lateral parts of the dorsal wall by two deep furrows. These lateral parts "lembram branchias secundárias"; they are obviously gills (op. cit., Pl. X, fig. 42). As to the "dorsal lip," it also is ciliated, and resembles a small median gill. — M. also gives a figure of the sexual organs (1944, Pl. XIII, fig. 57). It differs from that given by CHEN for *D. perrieri*, insofar as the vasa deferentia join the atria near the top instead of at the lower part, and the spermathecal ampulla is round, without constrictions; it wholly resembles that figured by BEDDARD (1899) for *D. perrieri*.

Some authors have united *D. obtusa* and *D. perrieri*. Thus Golanski (1911, according to Szarski, 1936 b, p. 388, foot-note) unites them under the name of *D. communis*, which is of course erroneus, as the name must be *D. obtusa* (cf. Černosvitov, 1942 a, p. 206). — Černosvitov (1942) also unites the two, under the appropriate name of *D. obtusa*. He has, however, another conception of the gills than that given above, having examined specimens from Palestine. The setae agree very well with the former descriptions (op. cit., Figs. 22—25). The distal tooth of the ventral setae behind V is anteriorly slightly longer than the proximal, but posteriorly grows shorter and much thinner. The lengths given are: ventral setae of II—V, 103—115 μ, the rest 57—80 μ, needles 62—75 μ, hairs 140—160 μ. They thus agree very well with those given by previous authors. The branchial fossa is stated to be prolonged backwards (op. cit., Figs. 26—31), with 2 pairs of ventral finger-shaped gills, the anterior shorter, or, occasionally, one pair, the former having fused (cf. *D. digitata*, p. 173), and situated at the lower face of the latero-dorsal wall, usually 1 pair of ciliated swellings, visible only when the fossa is fully expanded. When it is contracted, the borders form a dorsal, longitudinal slit, broader in front and behind. s [illegible] up to 65. A stomachal dilatation is present in IX—X, or X. It seems probable that Č. is right in joining this form with *D. obtusa* (cf. the conditions in *D. nivea*).

I have found a form, which was represented by only 2 specimens, which I refer to *D. obtusa*. It agrees well with Piguet's and Schuster's descriptions. The ventral setae in II—V are 4—5 per bundle, about 120 μ long, 2 μ thick, with a proximal nodulus and long teeth, the distal about 12 μ long, the proximal 6.5—8 μ. The other ventral setae are 3—4 per bundle, 60—72 μ long, the thickness increasing from 2 μ to 3 μ from the inner to the outer setae in one bundle, the teeth changing from $\frac{4.5\ \mu}{4.5\ \mu}$ to $\frac{4.8\ \mu}{4\ \mu}$ at the same time. — The needles 1, occasionally 2, per bundle are 50—72 μ long and about 1.7 μ thick, with the distal part fairly strongly curved, and with short, equal teeth (Fig. 20 *A*, p. 193), about 1.5 μ long. The hairs are 130—150 μ long. — The branchial fossa is roundish, prolonged backwards, and contains 3 pairs of gills, two posterior ventral, finger-shaped in life, and one more dorsal, foliate (Pl. XVIII, fig. 5). When preserved all look more or less knob-like, not ridge-like as in *D. digitata*. There is a stomachal dilatation in IX—X, septal glands in IV—VI, most well-defined in V—VI, contractile loops in VI—X; the dorsal vessel was situated ventrally, to the left. n was = 20 and 21 respectively, l = about 5 mm (preserved). No observations were made on tube-dwelling (Wolf states that he found *D. obtusa* in tubes). The specimens swam in the same manner as *D. digitata*, with spiral movements.

The extreme seta measurements found thus are: ventral setae of II—V 95—120 μ, the rest 57—82 μ, needles 50—75 μ, hairs 98—182 μ.

Dero latissima Bousfield (1886) was no doubt only an occasional form of *D. obtusa*, with a very broad fossa.

Probably *Dero polycardia* Hayden (1922) belongs to *D. obtusa*. The setae are somewhat longer than usual ventrally, 135 μ in II—V, 95 μ behind, needles 87.5 μ, hairs about 300 μ, and the number of contractile loops may be higher, up to 8, in VI—XIII, but these characters certainly cannot be considered as lying outside the possible range of *D. obtusa*. The stomach is in IX—X, and the branchial apparatus seems to agree perfectly: "Respiratory bursa with dorsal lip, consisting of a median portion and two lateral ciliated processes. Gills, two pair, of the pyramidal type."

Dero nivea Aiyer, 1930.

Fig. 19 *G*; Pl. XVIII, fig. 4.

Dero niveum AIYER, 1930, pp. 40—41, Figs. 16—17.
Dero palestinica ČERNOSVITOV, 1938 a, pp. 541—543, Figs. 5—10.
[*?*] *Dero obtusa* d'Udekem. CHEN, 1940, pp. 55—56, Fig. 16 A.

Dorsal setae from VI on, 1 hair, and 1 bifid needle with equal teeth; ventral setae about 4 per bundle, in II—V longer and thinner than the rest, with distal tooth almost twice as long as proximal, and nodulus proximal; in the remaining segments teeth about equally long, and nodulus distal. Stomach in VIII—IX; septal glands in IV—VI. Branchial fossa slightly prolonged backwards, with 3 pairs of short, stumpy gills, 2 ventral, 1 dorsal, or with 2 pairs of ventral gills, and 1 pair of dorsal, ciliated swellings. Dorsal vessel ventrally to left; commissural contractile vessels in VI—VIII. $n = 14$. $s = 23—45$. $l = 2.5—10$ mm.

Europe, Palestine, India, China (?).

Sweden: Trehörningen.

The hair setae in *D. nivea* are reported by AIYER to be 108—118 μ long, the needles 45—48 μ, the anterior ventral setae 81—84 μ, with nodulus proximal, and distal prong about twice as long as proximal, the rest 52—58 μ long, with distal nodulus, and prongs equally long. The stomachal dilatation is stated to begin in VIII. The branchial fossa, prolonged somewhat behind the gills (op. cit., Fig. 17), has three pairs of short gills, the anterior pair originating from the lateral parts of the dorsal wall of the fossa, above the anus. There are three pairs of vascular loops, in VI—VIII. n is stated to be $= 14$, $s = 23—30$, l (simple specimens) $= 2.5—3.5$ mm, (chains) $=$ 5 mm.

Identical with this species seems to be *D. palestinica* Černosvitov (1938). It has precisely the same gill arrangement, and the fossa slightly prolonged backwards (cf. op. cit., Figs. 9, 10). The shape and number of the setae is the same, but the size of the ventral setae is somewhat smaller: hairs less than 150 μ, needles 42—44 μ, ventral setae of II—V, 64—66 μ. It is stated to have chloragogen beginning in VII (VI in *D. nivea*), and no stomach, and Černosvitov argues that these differences together with the smaller setae are enough to distinguish the two forms as species; as to the stomach, however, Č. often states it to be absent also when there is one, and the setal differences seem far too small. The beginning of the chloragogen may probably vary.

Chen (1940) reports *D. obtusa* from China. He gives no data of the setae, and only mentions that the "branchial fossa is only slightly broader than body and prolonged posteriorly, antero-lateral edge of fossa expanded and folded dorsally, not forming a secondary gill, with a dorso-median lip." This seems to mean that there are only two pairs of gills. The figure (Fig. 19 *G*, p. 172) shows two pairs of small gills, much shorter than the long, finger-shaped gills of his *D. perrieri*, the anterior border of the fossa with two lateral, ciliated processes, very suggestive of gills, or ciliated swellings. He gives $n = 18$—22, $l = 5$ mm, breadth 0.1—0.2 mm (against 0.2—0.24 mm in *D. perrieri*). It seems fairly probable that this small species really belongs here, as it is obviously not identical with *D.* "*perrieri*" (= *obtusa*).

I have found one form, which I identify with *D. nivea*. It was one specimen only. The setae of II—V are about 75 μ long, with teeth $\frac{7.5\,\mu}{4.5\,\mu}$—$\frac{9\,\mu}{6\,\mu}$, the other ventral setae about 60 μ, with teeth $\frac{3.5\,\mu}{3.5\,\mu}$—$\frac{4.2\,\mu}{4.5\,\mu}$. Only two pairs of gills were visible in the contracted specimen (Pl. XVIII, fig. 4), but sections showed the presence of a pair of dorso-lateral ciliated swellings, quite as in Černosvitov's *D. obtusa* from Palestine. The branchial fossa was prolonged backwards, behind the gills. The gills, like all other organs were much smaller in this specimen than in *D. obtusa*. — There were septal glands in IV—VI, though poorly defined in IV, and a stomach beginning in VIII, as in Aiyer's specimens. The dorsal vessel was situated ventrally, to the left of the gut, and contractile loops were found in VI—VIII in this specimen too. $s = 26$, l (preserved) = about 2 mm. Thus, all characters agree very well with those of *D. nivea* (including *D. palestinica*), except for the presence of a pair of swellings instead of the first pair of gills. It seems, however, very probable, that *D. nivea* may vary in this respect in analogy with *D. obtusa* (cf. p. 183) only the geographical conditions seem to be somewhat the reverse, so that 3 pair of gills are present in Palestine, and 2 pairs of gills + 1 pair of swellings in Europe.

The characters separating this species from *D. obtusa* seem to be: the far smaller size of the body, and of the setae, the situation of the stomach (in VIII—IX instead of IX—X), the number of contractile loops (3 against usually 4—5), and the shape of the gills (anterior pair short, stumpy, or only swellings, against foliate, posterior pairs shorter).

Dero sawayai Marcus, 1943.

[?] *Dero heterobranchiata* Michaelsen, 1933, pp. 332—333, Pl. I, fig. 2.
Dero sawayai Marcus, 1943, pp. 35—37, Pl. IV, fig. 19, Pl. V, fig. 20.
Dero sawayai Marcus. Marcus, 1944, p. 50.

Dorsal setae from VI on, 2 hairs, and 2 bifid needles, with proximal tooth longer and thicker than distal; ventral setae of II—V, 4 per bundle, much longer than the rest, with proximal nodulus, and distal tooth longer than proximal; in the remainder 4 per bundle, with proximal tooth longer and thicker than distal, and distal nodulus. Stomachal dilatation beginning in VIII. Branchial fossa with 2 pairs of finger-shaped gills, 1 ventral and 1 dorsal. Dorsal vessel ventrally on the left side; contractile loops in VI—VII. $n = 13—14$. $l = 3—6$ mm. Constructs fixed mucous tubes with foreign matter.

S. America (Brazil).

The hair setae are stated to be 80—85 μ long, the needles 38 μ, the anterior ventral setae 78 μ, the posterior 43 μ.

Possibly *Dero heterobranchiata* Michaelsen, from West India may belong here. The shape of only the posterior part of the body is known. The dorsal bundles have 1—2 very fine needles, and 2 hairs, less than 100 μ long; the ventral bundles 3—4 setae per bundle, 50—65 μ long, with equally long teeth. The branchial fossa is small, with 2 pairs of gills, 1 ventral, short and thick, cylindrical, and 1 dorsal, very long and slender, 200 μ long (preserved). The shape of the gills is described from one preserved, incomplete specimen, and must not be too much relied upon.

Dero multibranchiata Stieren, 1892.

Dero multibranchiata Stieren, 1892, pp. 107—114, 121, Pl., figs. 1—4.
Dero multibranchiata Stieren. Beddard, 1895, p. 301. Michaelsen, 1900, p. 29. Marcus, 1944, pp. 65—66, Pl. XIII, figs. 55—56.

Dorsal setae from VI onwards, 1 hair, and 1 needle, bifid, with proximal tooth weak or vestigial, and nodulus $^1/_3$ from the tip; ventral setae 4—6 per bundle, those of II—V longer than the rest, with nodulus proximal, and teeth long, distal one longer; posteriorly nodulus median or distal, distal tooth shorter. 7 pairs of digitiform gills. $n = 27—30$. l (preserved) = 7—10 mm. Swims with serpentine movements. In mucous tubes.

Brazil, Trinidad.

The needles are stated by Marcus (cf. op. cit., Pl. XIII, fig. 56 C, D) to be 90 μ long, the hairs 170—190 μ, the anterior ventral setae 130 μ long, with teeth $\frac{11\ \mu}{8\ \mu}$, the posterior 80 μ.

The species was included by CHEN (1940) within *D. limosa*, he himself having found the latter with cloven gills. MARCUS rejects the union, probably rightly, with reference to the different shape of the needles.

Dero botrytis Marcus, 1943.

Dero botrytis MARCUS, 1943, pp. 37—39, Pl. V, figs. 21—22.

Dorsal setae from VI onwards, 1 hair and 1 finely bifid needle, with proximal tooth slightly thicker than distal; ventral setae of II—V, 6—7 per bundle, longer than the rest, with nodulus proximal and distal tooth longer and thinner than proximal; in the remaining segments 4—6 per bundle, with distal nodulus, and distal tooth shorter and thinner than proximal. Contractile vascular loops in VII—XII. Branchial fossa disc-shaped, with about 40 pairs of finger-shaped gills. Clitellum in V—$^1/_2$VIII; spermathecal ampulla very large, extending forwards to III; no penial setae. $n = 34$. $l =$ up to 30 mm.

S. America (Brazil.)

The hair setae are stated to be about 400 μ long, the needles 120 μ, the anterior ventral setae 182—195 μ, the posterior 130—135 μ.

Dero pectinata Aiyer, 1930.

Dero pectinata AIYER, 1930, pp. 36—38, Figs. 12—13.
Dero pectinata Aiyer. MICHAELSEN, 1933, pp. 335—336.

Dorsal setae from VI on, 1 plumose hair, and 1 needle, with three equal teeth, and nodulus weak, about $^1/_6$ from the tip; ventral setae of II—V, 4 per bundle, about twice as long as, and straighter and thinner than the rest, with longer distal tooth, and nodulus proximal; in the following segments 2—4 per bundle, with longer and thicker proximal tooth, and nodulus distal. Septal glands in III—V; stomach in VIII. 2 pairs of small, knob-like gills from the ventral wall of the fossa. Dorsal vessel ventrally to the left; 2 pairs of contractile loops, in VI—VII. Nephridia behind septum dilated to form a bladder. Clitellum in V—VII; no penial setae. $n = 14—15$. $s = 19—25$. $l =$ about 2 mm.

S. India, West-India (oligohaline).

This species has dorsal setae unique in the subgenus, the needles being trifid (AIYER, 1930, Fig. 12 c) and the hair setae with a one-sided, feather-like serration (op. cit., Fig. 12 d). The needles are 37 μ long, the hairs 78 μ, the anterior ventral setae 70—78 μ, the posterior 39 μ.

Dero palmata Aiyer, 1930.

Fig. 18 *A*.

Dero palmata AIYER, 1930, pp. 39—40, Figs. 14—15.

Dorsal setae from VI on, 1 hair, and 1 palmate needle, with distal nodulus; ventral setae of II—V, 4 per bundle, nearly twice as long as the rest, with proximal nodulus, and distal tooth twice as long as proximal; the rest 2—4 per bundle, with distal tooth shorter than proximal, and nodulus distal. Stomach in VIII. Branchial fossa with 3 pairs of finger-shaped gills, 1 lateral, 2 ventral. 3 contractile loops, in VI—VIII. $n = 14—15$. $l =$ about 3 mm.

S. India.

Aiyer's figure of a palmate needle is reproduced in Fig. 18 *A*, p. 159. The wide distal end is stated to be 13.5—15 μ wide. The length of the needles is stated to be about 52 μ, the hairs 90 μ, the anterior ventral setae 90 μ, the rest 48—49.5 μ.

Dero asiatica Černosvitov, 1930.

Dero asiatica Černosvitov, 1930, pp. 10—13, Figs. 1—10.

Dorsal setae from VI on, usually 1 hair and 1 needle, with strongly diverging prongs and 3—4 fine intermediate teeth; ventral setae in II—V straighter and thinner than the rest, with proximal or median nodulus, and longer distal tooth, those following about equally long, with distal tooth equally long as, or slightly shorter than proximal, and nodulus median or distal, the shape changing gradually backwards. Stomach in X (?). Branchial fossa with a median incision in the dorsal margin; 2 pairs of gills (?). Clitellum in V—VII. Spermathecal ampulla small, thin-walled, duct short, opening laterally; vasa deferentia short, wide; atrial ampulla small, globular, duct narrow, short, piercing an aggregation of gland cells surrounded by strong muscles; penial setae 4—5 per bundle, obtuse, single-pointed, without nodulus. $s = 36$. $l =$ about 4 mm.

Turkestan.

The needles are stated to be 42—44 μ long, the hairs 100—200 μ, the anterior ventral setae 50—54 μ, those following 53—60 μ, thus not shorter than the preceding, contrary to the common condition.

The lateral openings of the spermathecae, and the aberrant shape of the penial setae (Černosvitov, 1930, Fig. 5) distinguish this species from the other *Dero*, the sexual organs of which are known.

Dero evelinae Marcus, 1943.

Dero evelinae Marcus, 1943, pp. 39—55, Pl. VI, Pl. VII, figs. 27—31, Pl. VIII, Pl. IX, figs. 34—38.

Dero evelinae Marcus. Marcus, 1944, pp. 64—65, Pl. XIII, figs. 53—54.

Dorsal setae from VI on, 1 hair seta, and 1 finely bifid needle per bundle; ventral setae of II—V, 3—4 per bundle, longer than the rest, with nodulus proximal and distal tooth longer than proximal; in the remaining bundles 4—6 setae per segment, with nodulus distal, and proximal tooth equally long as distal but thicker. Stomach beginning in IX. Branchial fossa with 8 pairs of finger-shaped gills, partly bilobed. Contractile vascular loops in VI—XVI. Clitellum in $^1/_2$V—$^1/_2$VIII; spermathecal ampulla globular, duct long, well-defined, male funnels large, vasa deferentia entering atria at the top; atrial ampulla pear-shaped, reflected backwards, covered with prostate gland cells; atrial duct long, surrounded by gland cells. No penial setae. $n = 34$. $l = 8$—18 mm. Constructs fixed mucous tubes.

S. America (Brazil).

This species alone in the genus is very remarkable in having atria with prostate covering. — The length of the setae is stated to be: ventrally in II—V, 157 μ, in the remainder 85 –95 μ, hairs 240—250 μ, needles 80 μ.

*

Among the species of *Dero s. str.*, some show indisputable relations to each other. Thus, *D. digitata* and *zeylanica* are, as has been stressed before (p. 179), closely related, and also *D. cooperi* to them. They all have foliate gills, and bifid needles. Among the rest, *D. obtusa* and *nivea* closely resemble the afore-mentioned, but the gills are chiefly digitiform. *D. sawayai*, as far as is known, seems to be closely related to *D. obtusa* and *nivea*. *D. botrytis*, which has also bifid needles of similar shape to the preceding forms, and digitiform gills, differs in its gill-arrangement, with masses of gills on a flat fossa, and in the spermathecal ampulla being extremely large and stretching forwards for a couple of segments, contrary to the usual state in the family (the other sexual organs are not described). It is also bigger, up to 30 mm, with very long setae. It seems to occupy a fairly separate position. About *D. multibranchiata* too little is known to allow of any conclusions. Its needles deviate in having a reduced proximal tooth. *D. evelinae* no doubt is fairly remote from the other *Dero*, with its lobed gills, and aberrant sexual organs (prostate glands on the atria).

In the remaining species with dorsal setae from VI, the needles are pectinate, or palmate. Among these, *D. pectinata* and *palmata*, both minute species, have not been studied enough to allow of any conclusions, but apart from the needles, their known characters remind one of the *obtusa* group. *Dero asiatica*, unlike the rest, has ventral setae gradually changing shape backwards, spermathecae opening laterally, and penial setae with a shape of their own.

The only species with dorsal setae beginning in IV, *D. dorsalis*, resembles the *digitata* group in having part of the gills foliate, but is reminiscent of the *furcatus* group of *Aulophorus* in having the ventral setae gradually changing backwards; also, there are processes from the posterior angles of the branchial fossa, reminiscent of very short palps. It is certainly not especially related to *A. superterrenus*, which also has dorsal setae from IV, as was tentatively suggested by SCHUSTER (1915) and STEPHENSON (1931 a).

Subgenus **Aulophorus** Schmarda, 1861.

Subgeneric type: *Aulophorus furcatus* (Müller).

Dorsal setae present from IV, V, or VI onwards; ventral setae of II—V different or not different in shape from those of following segments. Stomachal dilatation present or absent. Posterior border of branchial fossa projecting into two palps. Coelomocytes present or absent. Spermathecae rarely absent; vasa deferentia joining atria at anterior side; no prostate glands; usually no penial setae. Budding or fragmentation. Usually living in portable tubes.

Aulophorus superterrenus Michaelsen, 1912.

Aulophorus superterrenus MICHAELSEN, 1912, pp. 112—116, Pl. III, figs. 5—6.

Aulophorus superterrenus Michaelsen. STEPHENSON, 1931 a, pp. 270—272, Fig. 3. MICHAELSEN, 1933, p. 335. MARCUS, 1943, pp. 92—98, 134—143, 152, 154 ff., Pl. XVII, XVIII, Pl. XIX, figs. 76—79, Pl. XXVI, figs. 107—108, Pl. XXVII, Pl. XXVIII, figs. 109—111, Pl. XXIX, fig. 114, Pl. XXX, fig. 121, Pl. XXXIII, figs. 126-127; 1944, p. 50.

Dorsal setae from IV onwards, 1—3 hairs and 1—3 bifid needles with thicker proximal tooth; ventral setae 5—10 per bundle, in II—V slightly shorter than the rest, all of approximately the same shape, with distal nodulus, and proximal prong thicker than distal, but equally long or shorter. 4 pairs of foliate gills, 2 ventral, 1 lateral, 1 dorsal; lateral pair occasionally lobed and fused. Palps fine, slightly diverging. Dorsal vessel on left side of the gut; contractile loops in VI—X; non-contractile, bifurcate loops in all segments from XI backwards. Clitellum in V—VII; spermathecal ampulla pear-shaped, duct moderately long; male funnels very large, entering atria at lower part of anterior face; atrial ampulla small, spherical, duct short, with gland cells; ducts of both sides opening into a common invagination of the body-wall; penial setae present, with a simple hook; one pair of pear-shaped glandular masses in IV, in front of the ventral setal bundles. $s = 68—128$. l (preserved) $= 10—18$ mm, (living, out-stretched) = up to 60 mm. Fragmentation. No swimming. No tube-formation.

S. America, Malacca. In tree-holes and water-basins of epiphytes.

The ventral setae are stated to be 63—95 μ long, the needles 54—100 μ, the hairs 250—450 μ. The commissural vessels are bifurcate, the two branches uniting again before entering the ventral vessel. STEPHENSON states that asexual reproduction is represented by a sort of architomy, the two foremost segments of the posterior fragment shedding their dorsal setae, and becoming II and III of the new individual. According to MARCUS (1943) it consists of "precocious paratomy," i. e. regenerative materials are stored in the region where the fragmentation is going to take place, and according to him, 5 segments are formed at the anterior end.

Aulophorus furcatus (Müller, 1773).

Fig. 20 *B—D*.

Das geschmeidige Wasserschlänglein mit zwey Gabelspitzen Rösel von Rosenhof, 1755, pp. 581—584, Pl. XCIII, figs. 8—16.
Die augenlose Naide Müller, 1771, p. 95, foot-note.
Nais furcata Müller, 1773, p. 23.
[*non*] *Nais* (*Dero*) *furcata, florifera* Oken, 1815, p. 363.
Uronais furcata (Roesel). Gervais, 1838, pp. 18—19.
Dero digitata (Müller). d'Udekem, 1855, p. 549; 1859, p. 18. Vaillant, 1890, pp. 381—382.
Dero palpigera Grebnitzky, 1873, p. 268. [*fide* Czerniavsky, 1880 = *D. rodriguezii* Semper].
Dero Rodriguezii Semper, 1877, pp. 106—107, Pl. IV, figs. 15—16.
Dero Rodriguezii Semper. Czerniavsky, 1880, p. 312.
Dero furcata Oken. Bousfield, 1887, pp. 105—106, Pl. V, figs. 17—18. Stieren, 1892, pp. 119, 122. Beddard, 1895, p. 299. Michaelsen, 1900, pp. 29—30; 1903 b, p. 184. Piguet, 1906, pp. 278—279. Galloway, 1911, pp. 304—305.
Dero palpigera Grebnitzky. Vaillant, 1890, pp. 382—383.
Aulophorus furcatus (Oken). Michaelsen, 1905 b, p. 308; 1909 a, p. 25, Fig. 40. Piguet & Bretscher, 1913, p. 45. Stephenson, 1914, pp. 332—334; 1916, pp. 306—307, Pl. XXX, fig. 3; 1923, pp. 92—93, Fig. 34. Smith, 1918, p. 639. Ude, 1929 p. 33, Fig. 34. Aiyer, 1930, p. 43. Michaelsen & Boldt, 1932, p. 597. Černosvitov, 1937 b, p. 145; 1942 a, pp. 201—202, Figs. 16—20. Chen, 1940, pp. 61—62. Marcus, 1943, pp. 87—92, Pl. XIV, fig. 61, Pl. XV, figs. 66—69, Pl. XVI; 1944, p. 50.
[*?*] *Aulophorus palustris* Michaelsen, 1905 b, p. 308.
Dero sp. Stephenson, 1910 a, pp. 71—76.
[*?*] *Aulophorus furcatus* var. *brevipalpus* Golanski, 1911.
Aulophorus stephensoni Michaelsen, 1912, p. 116.
[*?*] *Aulophorus palustris* Michaelsen. Stephenson, 1913, pp. 255—257, Pl. I, fig. 5; 1916, p. 306.
[*?*] *Aulophorus africanus* Michaelsen, 1914, pp. 152—153, Pl. IV, figs. 1—3.
Dero roseola Nicholls, 1921, pp. 90—94.
[*?*] *Aulophorus michaelseni* Stephenson, 1923, pp. 93—94, Fig. 35.
[*?*] *Aulophorus michaelseni* Stephenson. Aiyer, 1930, p. 43, Fig. 18.

Dorsal setae from V onwards, 1 hair and 1 bifid needle with slightly longer proximal tooth, and nodulus $^1/_3$ from the tip; ventral setae of II—IV, 2—5 per bundle, with long prongs, distal one longer than proximal; from V onwards slightly shorter, with teeth subequal. Stomachal dilatation defined or not, beginning in VII or VIII. Branchial fossa with parallel palps, and 3 or 4 pairs of gills. Septal glands in IV—VI. 2—5 contractile loops from VI or VII to VII—X. Coelomocytes present or absent. Clitellum in V—VII; spermathecal ampulla large, ovoid or long, tubular, entering the sperm-sac, duct narrow; male funnels cup-shaped; vasa deferentia entering atria at anterior side; atria small, thin-walled, subspherical, duct short, surrounded by gland cells; no penial setae. Budding present. $n = 11—25$. $s = 35—82$. $l = 6—20$ mm. Swimming with transverse horizontal movements. Constructs attached or portable tubes, with foreign matter.

Cosmopolitan.

Sweden: Uppsala (hothouse).

The *Nais* (*Dero*) *furcata*, *florifera* of Oken (1815) is not this species, but the "*Blumenthier*" of Müller (= *Dero digitata*).

Not having had access to Golanski's (1911) paper, I include his var. *brevipalpus* within *A. furcatus.*

Stephenson (1916) has shown that the number and appearance of the gills may vary considerably, from 3 pairs, the anterior being hardly distinguishable from the dorsal wall of the fossa, to 4 pairs. The last stage is represented by *A. stephensoni* Mich., which is included within *A. furcatus* where Chen (1940) found 3 pairs of "true" gills (cf. p. 168, foot-note) and the dorsal wall of the fossa with or without a pair of "secondary" gills. Stephenson (op. cit.) is also inclined to include *A. palustris* Mich., recorded by himself (1913) from Ceylon, in *A. furcatus.* In 1923, however, he separates the Indian specimens of *A. palustris* under the name of *A. michaelseni* from those described by Michaelsen, on account of the needles of the latter being referred to as "Hakenborsten," which term S. considers applicable only to setae resembling ventral setae in form. Michaelsen, however, uses the term more than once for needles resembling those of *A. furcatus*, e. g. for *A. borellii* (Michaelsen, 1900), so that this objection does not hold. Michaelsen's description is very short and altogether unsatisfactory, but nothing clashes with the identification. Against including it in *A. furcatus*, Stephenson (1923) points out the ventro-lateral position of the dorsal vessel in *A. palustris* (*michaelseni*), whereas in *A. furcatus* he found it to be dorsal. This statement is rather embarrassing, as in my material of *A. furcatus* it is ventro-lateral. It must thus be assumed, either that the position of the dorsal vessel may vary, or that Stephenson was mistaken, or that he had another form before him. Stephenson's specimens also had a much more acute angle between the teeth of the needles than mine had (cf. Stephenson, 1923, Fig. 34). Also, S. found no stomachal dilatation, whereas I found one in VII—VIII, and in S.'s specimens there were commissural loops in VI—IX, in mine only 2, in VI—VII. Very possibly the species consists of several races.

The extreme seta measurements found in the literature for *A. furcatus* are: ventral setae in II—IV, 54—72 μ, posteriorly 53—68 μ, needles 45—62 μ, hairs 109—200 μ. In *A. michaelseni* the ventral setae of II—IV are stated to be 76—84 μ, the posterior 68 μ, thus somewhat longer than in *A. furcatus*, but not so much as to exclude the identity.

Aulophorus africanus Michaelsen, probably belongs to *A. furcatus*, the form of the setae (the length being unknown) agreeing very well with the latter (cf. Michaelsen, 1914, Pl. IV, figs. 1, 2). The only difference seems to be the very slight incision in the dorsal border of the branchial fossa, and the form of the gills, which are stated to be "dick-wulstig bis plattenförmig." Chen, however, states the posterior gills in *A. furcatus* to be

flattened, so presumably the form may vary. MICHAELSEN himself writes: "Ich glaubte anfangs *Aulophorus furcatus* (Oken) vor mir zu haben, musste aber nach genauerer Untersuchung annehmen, dass die obersten beiden Kiemen nicht am Rande des Kiemennapfes, sondern eben noch innerhalb desselben stehen, also primäre Kiemen sind. Von *Au. furcatus* unterscheidet sich *Au. africanus* übrigens auch durch die Stellung der Palpen, die bei *Au. furcatus* in stumpfem Winkel divergieren, bei *Au. africanus* dagegen dicht nebeneinander stehen und nur sehr wenig, in spitzem Winkel, divergieren." None of these characters seem to warrant a specific separation.

Dero roseola Nicholls (1921) does not seem to be specifically different from *A. furcatus*. As MARCUS (1943, p. 88) points out, the chief difference is the different length of the zooids.

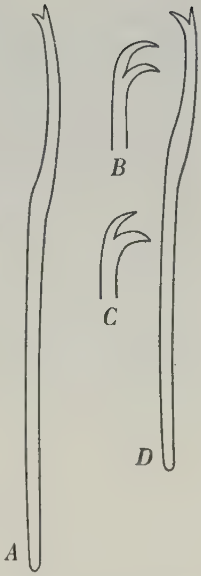

Fig. 20. *A Dero obtusa*. Needle seta. *B-D Aulophorus furcatus*. *B* distal end of ventral seta from II, *C* from a posterior segment, *D* needle seta. 1200 ×.

The length and shape of the ventral setae in my specimens are somewhat intermediate between those described by STEPHENSON (1914) and ČERNOSVITOV (1942 a). In one specimen they are 4 per bundle, in II—IV, 67—72 μ long, with the distal tooth slightly longer than the proximal (Fig. 20 *B*), and equally thick. From V onwards the setae are shorter, about 55 μ, but in V and VI the distal tooth is still longer than the proximal, and equal in thickness. In VII the proximal tooth becomes equally long, and thicker, backwards it grows thicker still, and shorter than the distal (Fig. 20 *C*), the number being 3—4. The needles are 50—54 μ long, with the distal tooth shorter and thinner (Fig. 20 *D*), the teeth widely diverging. The hairs are 85—130 μ long. The coelom of IV, V, and VI is filled up with huge septal glands. The gills are 3 pairs, digitiform, the most anterior being dorsal. The palps are parallel. $n = 16—23$.

It is not easy to know if these specimens represent the same race as that found elsewhere in Europe, as the material was collected from a basin in the tropical house of the Botanical Garden, Uppsala, and may thus have been brought from abroad.

The sexual organs were described by STEPHENSON (1914) and MARCUS (1943), but the descriptions differ in a number of points. Thus, the spermathecae are stated by STEPHENSON to have a large, ovoid ampulla, and a long duct, whereas according to MARCUS the ampulla is very long and tubular, stretching within the sperm-sac through VI and VII, and the duct is short (op. cit., Pl. XVI, figs. 68, 70). The vasa deferentia in STEPHENSON's specimens entered the anterior face of the small, sub-spherical atria, whereas in MARCUS' they entered near the top of oblong, reflected atria. The differences seem too great to depend on different degree of development only. STEPHENSON'S description is, however, short, and not accompanied by any figures. It may be supposed that the descriptions refer to different geographical races, though the setal characters agree very well, and ČERNOSVITOV (1942 a), who had material from both India and S. America, does not report any difference whatever.

Aulophorus borellii Michaelsen, 1900.

Dero sp. COGNETTI, 1900, pp. 1—2, Fig. 1.
Dero borellii MICHAELSEN, 1900, p. 522.
Aulophorus borellii (Michaelsen). MICHAELSEN, 1927 b, p. 369. STEPHENSON, 1931 c, pp. 305—306, Pl. XVII, fig. 4.

Dorsal setae from V on, 1 hair and 1 bifid needle, with teeth equally long, the proximal being thicker; ventral setae of anterior segments 4—5 per bundle, with nodulus slightly distal, and distal tooth slightly longer, and much thinner than proximal; in posterior segments 2—3 per bundle, with nodulus more distal, teeth equally long. 4 pairs of ridge-like gills. s = up to 154. l (preserved) = up to 35 mm. Probably fragmentation.

S. America.

The needles (cf. STEPHENSON, 1931 c, Pl. XVII, fig. 4) are stated to be 120 μ long, the hairs less than 440 μ, the anterior ventral setae 148 μ, the posterior 100—125 μ. There is no stomachal dilatation, according to the descriptions.

Aulophorus pectinatus Stephenson, 1931.

Aulophorus pectinatus STEPHENSON, 1931 c, pp. 308—309, Pl. XVII, fig. 6.

Dorsal setae from V on, 1 hair and 1 bifid needle, with 2—4 intermediate teeth; ventral setae of anterior segments 3—4 per bundle, in posterior 2—3 per bundle, with nodulus more or less distal, and prongs about equally long, the proximal being thicker. Gills 4 pairs. Palps diverging. s = 108—113. l (preserved) = 12—16 mm. Probably fragmentation.

S. America.

The needles (loc. cit., Pl. XVII, fig. 6) are 102 μ long, the hairs 280 μ, the posterior ventral setae 106—140 μ long. STEPHENSON could not ascertain whether there was any difference in shape between the anterior and posterior ventral setae. Nothing is stated about the form of the gills. There is stated to be no stomachal dilatation.

Aulophorus gravelyi Stephenson, 1925.

Aulophorus gravelyi STEPHENSON, 1925 c, pp. 46—48, Pl. III, fig. 2.
Aulophorus gravelyi Stephenson. MICHAELSEN & BOLDT, 1932, p. 597.

Dorsal setae from VI onwards, 2—3 hairs, and 2—3 finely bifid needles, with slightly longer distal prong, and slightly distal nodulus; ventral setae 3—4 per bundle, those of II—V longer and straighter than the rest, with longer distal tooth, and nodulus median, those of following segments with equally long teeth, and nodulus median or slightly distal. Branchial fossa with 4 pairs of gills, the first pair dorsal, small, the second and third cylindrical, the fourth broader. No coelomocytes. Probably fragmentation. $s = 46—73$. l (preserved) = 5—8 mm.

S. India, Sumatra.

The ventral setae of II—V are stated to be 115 μ long, 3 μ thick, the rest varying from 62—90 μ in the same bundle; the needles 66—80 μ long, with teeth 2 μ, hairs 190—240 μ. There is stated to be no stomachal dilatation.

Aulophorus beadlei Stephenson, 1931.

Aulophorus beadlei STEPHENSON, 1931 c, pp. 306—307, Pl. XVII, fig. 5.

Dorsal setae from VI on, 1 hair, and 1 bifid needle, with short teeth, with an irregularity between the latter, and an inconspicuous nodulus, $^1/_3$ from the distal end; ventral setae of II—V, 5—6 per bundle, longer than the rest, with distal prong longer than proximal, and proximal nodulus; the rest 4—5 per bundle, with distal prong slightly longer than proximal, and nodulus distal. 4 pairs of foliate gills. No budding, probably fragmentation. $n = 19—26$. $s = 26—44$. l (preserved) = 4 mm. In mucous tubes.

S. America.

The ventral setae of II—V are stated to be 140 μ long, the rest 80 μ, needles 75 μ, hairs shorter than the body-diameter (0.25 mm). The "irregularity" between the teeth of the needles looks most like a couple of minute intermediate teeth (op. cit., Pl. XVII, fig. 5). The gills are stated to be ridges on the wall of the fossa; thus they will probably be foliate, when expanded. According to STEPHENSON there is no dilatation of the stomach.

Aulophorus caraibicus Michaelsen, 1933.

[?] *Aulophorus discocephalus* SCHMARDA, 1861, p. 9, Pl. XVII, fig. 151.
[?] *Aulophorus discocephalus* Schmarda. VAILLANT, 1890, p. 388. MICHAELSEN, 1900, p. 35.
Aulophorus caraibicus MICHAELSEN, 1933, pp. 338—341, Pl. I, figs. 7—9.

Dorsal setae probably from VI on, 1 hair, and 1 bifid needle with short teeth, possessing an intermediate webbing with concave border; ventral setae of II—V, 3 per bundle, probably slightly longer than the rest, with longer and slightly thinner distal tooth, those following 2—3 per bundle, with teeth equally long and thick. Branchial fossa with moderately long palps, about parallel, and 3 pairs of gills, 2 ventral foliate, 1 dorsal smaller. Probably fragmentation. $s = 28—40$. l (preserved) = up to 4.5 mm.

W. India (in oligohaline water).

The posterior ventral setae are stated to be about 45 μ long. — MICHAELSEN supposes the species to be possibly identical with *A. discocephalus* Schmarda, from Jamaica. This seems very probable, but not at all certain.

Aulophorus tonkinensis (Vejdovsky, 1894).

[?] *Aulophorus oxycephalus* SCHMARDA, 1861, p. 9, Pl. XVII, fig. 152.
[?] *Dero? oxycephala* (Schmarda). VAILLANT, 1890, p. 387.
[?] *Dero sp.*, STUHLMANN, 1891, p. 925.
[?] *Dero stuhlmanni* STIEREN, 1892, p. 123.
Dero tonkinensis VEJDOVSKY, 1894, pp. 244—245, Fig.
[?] *Dero stuhlmanni* Stieren. MICHAELSEN, 1900, p. 29.
Dero tonkinensis Vejdovsky. MICHAELSEN, 1900, p. 30; 1905 a, pp. 353—354.
Aulophorus tonkinensis (Vejdovsky). MICHAELSEN, 1909 b, p. 132. STEPHENSON, 1911, pp. 212—214; 1923, pp. 91—92; 1931 b, pp. 43—44; 1932, p. 236. AIYER, 1925, p. 35, Fig. 3. MICHAELSEN & BOLDT, 1932, p. 598.
[?] *Aulophorus stuhlmanni* (Stieren). MICHAELSEN, 1914, p. 155. CUNNINGTON, 1920, p. 574.
Aulophorus oxycephalus Schmarda. CHEN, 1940, pp. 62—65, Fig. 20.

Dorsal setae from VI onwards, 1 hair and 1—2 palmate needles with long prongs; ventral setae of II—V, 3—9 per bundle, longer than the rest, with distal tooth longer than proximal, and nodulus proximal; those following 3—7 per bundle, with distal tooth shorter and thinner than proximal, and nodulus distal. No stomachal dilatation. Branchial fossa funnel-like, normally with 2 pairs of long, cylindrical gills, 1 dorsal and 1 ventral. Commissural vessels in VII—VIII. Coelomocytes present. Clitellum in V—VIII, absent or weak ventrally in V; no spermathecae; vasa deferentia probably very thin, entering atria at middle; atrial ampulla elongate, enormously long, when full, reaching back into VIII; atrial duct long or short, curved; no penial setae. Budding present. $n = 13—18$. $s = 26—45$. $l = 2—5$ mm. In tubes with or without foreign matter. Swims.

S. and E. Asia, Africa.

The length of the hairs as taken from the literature is 96—160 μ, of the needles 64—80 μ, the edge of the web 6—8 μ (cf. STEPHENSON, 1931 b, Fig. 3), the ventral setae of II—V, 90—120 μ and the rest 52—80 μ. The number of gills may, according to STEPHENSON (1931 b, p. 44) be only one pair, or even a single one. The sexual organs, according to CHEN, are very remarkable, in the absence of spermathecae (cf. p. 54). The male funnels are stated to be formed by the thickened septum 5/6, which extends back along the atria, and probably enters them at their middle. This description seems to be misleading; the funnels appear to have fused with the septum, and the vasa deferentia are probably very narrow and thin-walled, and possibly short.

MICHAELSEN (1914) suggested that *A. oxycephalus* Schmarda is identical with *A. tonkinensis* (Vejdovsky); CHEN (1940) unites the two, possibly rightly. The insufficient description of the former, however, does not agree wholly with the latter, the number of ventral setae being much smaller (3 per bundle), and the number of hairs larger (likewise 3 per bundle). The similar manner of locomotion referred to by CHEN seems to be characteristic for all the tube-carrying forms.

Possibly *Dero stuhlmanni* Stieren belongs to this species. It is stated to have dorsal setae from VI on, 1 hair, and 1 simple-pointed needle; the last statement is, however, as was pointed out by MICHAELSEN (1914), almost certainly erroneous, as palmate needles often show themselves from the narrow side, and then appear simple. The ventral setae are 5 per bundle, gills 2 pairs, palps 1 pair. $l = 2$ mm. Thus, the characters agree very well.

Aulophorus schmardai (Michaelsen, 1905),

[?] *Dero vaga* Leidy. STIEREN, 1892, pp. 118—119, 123.
Dero Schmardai MICHAELSEN, 1905 a, pp. 350—353.
Aulophorus schmardai (Michaelsen). PIGUET, 1928, pp. 81—82, Fig. 1.

Dorsal setae from VI onwards, 1 hair and 1 palmate needle with very long teeth, and web without ribs; ventral setae of II—V, 6—8 per bundle, twice as long as the rest, with distal prong longer than proximal; those following 3—6 per bundle, with distal tooth mostly shorter than proximal. Septal glands in V—VII. Branchial fossa small, slit up dorsally, directed backwards, with fairly long, parallel palps, and at least 2 pairs of small gills, 1 dorsal, 1 ventral (possibly 2 ventral pairs). Budding present. $n = 15$. $s = 18$—21. l (simple, preserved) = 2—2.6, (chains, preserved) = 2.8 mm. In tubes plastered with sand and plant matter.

S. America (Paraguay).

The web of the needles is stated to be quite smooth, without ribs (cf. PIGUET, 1928, Fig. 1 D). The ventral setae of II—V are 124 μ long, 4 μ thick, the rest 60 μ long, 4 μ thick. The distal prong of the former is stated by MICHAELSEN to be thinner, by PIGUET thicker, than the proximal. — The gut is stated to have no visible stomachal dilatation.

The species seems to resemble *A. tonkinensis* very closely, only the gills are much smaller, and possibly one pair more. Possibly the present species is a geographical race of *A. tonkinensis*. If three pairs of gills are really present, the species may be identical with *Dero vaga* (Leidy) of STIEREN, which had 7—9 setae per bundle ventrally, and 3 pairs of gills.

A form *costata* of *A. schmardai* was described by DU BOIS-REYMOND MARCUS (1944), but I have not had access to her paper.

Aulophorus huaronensis (Piguet, 1928).

Aulophorus schmardai (Michaelsen) var. *huaronensis* PIGUET, 1928, pp. 82—83, Fig. 2.

Dorsal setae from VI on, 1—2 hairs, and 1—2 palmate needles, with long teeth, web ribbed; ventral setae of II—V, 4—6 per bundle, twice as long as, and straighter than the rest, with distal tooth longer and thinner than proximal; those following 2—4 per bundle, with distal tooth shorter and thinner than proximal. No septal glands. Branchial fossa dilated, directed obliquely upwards, with moderately long, parallel palps, and 3 pairs of gills, 2 ventral, cylindrical, 1 small dorsal. Budding present. $n = 17$—19. l (preserved) = 2.5—3 mm.

S. America (Peru).

The hairs are stated to be 128—149 μ long, the needles (op. cit., Fig. 2 e) 89 μ, the ventral setae of II—V, 132 μ, the rest 68 μ. There is stated to be no stomach.

This form seems to be specifically different from *A. schmardai*, on account of the absence of septal glands, the ribbed web of the needles, the smaller number of ventral setae, the difference in the shape of the branchial fossa, and (probably) the number of gills. It seems to resemble more closely *A. carteri*, which has 3 pairs of gills, and no septal glands, but, however, has no ribs in the webbing of the needles.

Aulophorus carteri Stephenson, 1931.

Aulophorus carteri Stephenson, 1931 c, pp. 303—304, Pl. XVII, figs. 2—3.
Aulophorus carteri Stephenson. Marcus, 1943, pp. 60—86, Pl. X, figs. 43—46, Pl. XI, XII, XIII, Pl. XIV, figs. 60, 62—63, Pl. XV, figs. 64—65; 1944, p. 50.

Dorsal setae from VI onwards, 1—2 hair setae, and 1—2 palmate needles with long teeth and web without ribs; ventral setae of II—V, 5—7 per bundle, about twice as long as the rest, with distal prong longer than proximal, and nodulus proximal; in the remaining segments 3—6 per bundle, with distal tooth shorter and thinner than proximal. Branchial fossa with slightly diverging palps, and 3 pairs of short gills, 1 ventral, 1 lateral, and 1 dorsal. Masses of gland cells in II—III; no definite septal glands. Clitellum in V—$^1/_2$ VIII; spermathecal ampulla globular, duct short, poorly defined; vasa deferentia long, curved, joining atria above atrial duct, atrial ampulla large, globular, duct short, surrounded by gland cells; no penial setae. Budding present. $n = 17$—23. $s = 21$—24. $l = 2$—10 mm. Swims with horizontal movements. Constructs portable tubes of foreign matter (spores etc.).

S. America.

The length of the hairs as stated in the literature amounts to 160—200 μ, and the needles 80—120 μ, with the span of the web 7—9 μ; the ventral setae are up to 120 μ in II—V, in the remainder 60—72 μ. The sexual organs were described by Marcus (1943). There seems to be no dilatation of the stomach.

Aulophorus vagus Leidy, 1880.

Aulophorus vagus Leidy, 1880, pp. 423—425, Figs. 3—4.
Aulophorus vagus Leidy. Reighard, 1885, pp. 88—106, Pl. I—III. Chen, 1940, p. 65.
Dero vaga (Leidy). Vaillant, 1890, pp. 383—384. Beddard, 1895, p. 300. Brode, 1898, pp. 141—180, Pl. XIII—XV. Galloway, 1899, pp. 115—140, Pl. I—V;

1911, p. 304. Michaelsen, 1900, p. 29. Walton, 1906, pp. 692—693. Smith, 1918, p. 639.
[*non*] *Dero vaga* (Leidy). Stieren, 1892, pp. 118—119, 123.

Dorsal setae from VI onwards, 1—3 hairs, and 1—3 palmate needles, sometimes with an intermediate tooth; ventral setae of II—V, 7—14 per bundle, longer and straighter than the rest, with proximal nodulus, and distal tooth longer than proximal; those following 4—7 per bundle with distal tooth much shorter and thinner than proximal. A stomachal dilatation in VIII—X; no septal glands. Branchial fossa when expanded roundish, directed obliquely upwards, with strongly diverging palps, and 1 (2?) pair of small, ventral gills. Contractile loops in VIII—X. Coelomocytes present. Budding present. $n = 16—21$. $s = 24—60$. $l = 5—10$ mm. In portable tubes with foreign matter.
N. America.

Dero vaga (Leidy) reported by Stieren (1892) was probably not this species, as it is stated to have 3 pairs of gills (cf. p. 197). It is not easy to get a clear conception of the number of gills in the present species. Reighard states 1 small pair; possibly the lateral borders of the fossa represent a second (op. cit., Pl. I, figs. 1, 5; cf. Walton, 1906, Fig. 5).

Aulophorus flabelliger Stephenson, 1931.
Fig. 18 *B*.

Aulophorus flabelliger Stephenson, 1931 b, pp. 44—46. Fig. 4.

Dorsal setae from VI on, 1 hair, and 1 palmate needle with strongly diverging prongs, and broad, obliquely cut web; ventral setae of II—V, 5—7 per bundle, more than double the length of the rest, straighter, with nodulus proximal, and distal tooth longer than proximal; those following with nodulus distal, distal prong $^1/_3$ as thick and $^1/_2$ as long as proximal. A stomachal dilatation beginning in VIII or IX. Branchial fossa with 3 pairs of long, cylindrical gills, and long, parallel palps. Budding present. $n = 17$. $s = 27$. l (preserved) $= 2.75$ mm. In tubes with foreign matter.
Africa (Kenya).

The hairs are stated to be 110—115 μ long, the needles (Fig. 18 *B*, p. 159) 50—60 μ, 3 μ thick, with the span of the web 18—19 μ at the edge, the ventral setae of II—V, 106—127 μ long, 3 μ thick, the rest, 49—53 μ long, 2 μ thick.

*

Three groups are discernible within *Aulophorus*, the most apparent feature separating them being the segment in which the dorsal setae begin, VI, V, or IV. — In the first-mentioned group the ventral setae of II—V are very well differentiated from the rest, often being twice as long as the latter, thinner, and straighter, with the distal prong longer than the proximal, and the nodulus more or less proximal, whereas the posterior setae have the distal prong equally long as, or shorter than the proximal, and a more distal nodulus. Only in this group are palmate needles reported. A number of species belonging here have been described; very possibly some of them are identical, though as yet too little is known to allow of any attempt to make definite conclusions. *A. tonkinensis, vagus, schmardai, huaronensis,* and *carteri* are very similar to each other, the differences in the immature specimens consisting in one pair of gills more or less, presence or absence of septal glands, and of ribs in the web between the needle teeth. *A. tonkinensis* and *carteri* are well differentiated from each other in their sexual organs, but the identities of *A. schmardai* and *huaronensis,* the sexual organs of which are not known, remain uncertain. — For the rest, it is difficult to judge the affinities of the species in the group. The needles form an almost continuous series from simple bifid in *A. gravelyi,* through bifid with an "irregularity" between the teeth in *A. beadlei,* bifid with a concave webbing in *A. caraibicus,* and "palmate," with a webbing with or without ribs between the teeth, in most species, to the extreme palmate needles of *A. flabelliger,* with their enormous "palm".

The group with dorsal setae from V on, contains only the closely similar forms *A. furcatus* and *borellii,* and *A. pectinatus,* with bifid, or pectinate needles. In these the shape of the ventral setae changes gradually backwards and the difference in shape between the anterior and posterior setae is much slighter than in the preceding group.

The group with dorsal setae from IV on, contains only the strongly aberrant *A. superterrenus,* with ventral setae all alike, with commissural vessels in all segments, atrial ducts opening in common, and no tube-formation.

The two last groups thus have more primitive features than the first in respect of the setae.

Allonais, gen.nov.

Generic type: *Allonais inaequalis* (Stephenson).

No eyes. Ventral setae of II—V only slightly different from those of following segments; dorsal setae normally from VI, hairs and double-pronged or pectinate needles. No septal glands. No stomachal dilatation. Usually a plexus in II—V, and simple vessels in some following segments. Coelomocytes present. Vasa deferentia joining atria above atrial duct; no prostate gland cells; penial setae present or absent. Fragmentation.

The present genus is composed of several of the species formerly referred to *Nais,* but differing so much from this genus as conceived of old, that they well merit the erection of a genus of their own. The majority of them form a very homogenous group, distinguished from *Nais* by having no eyes, the anterior ventral setae only weakly differentiated from the rest, no discernible stomachal dilatation (according to the literature), a vascular plexus in the anterior segments, and additional vessels, no prostate gland cells, and no formation of budding-zones. It should also be remarked that the genus *Allonais*, contrary to *Nais*, is confined to the tropical regions of the earth.

Allonais inaequalis (Stephenson, 1911).

(= *Nais pectinata* var. *inaequalis* Stephenson).

Fig. 21 *A—D*.

Nais pectinata Stephenson var. *inaequalis* STEPHENSON, 1911, pp. 208—209, Fig. 2.

Nais pectinata var. *inaequalis* Stephenson. MEHRA, 1920, pp. 458—463, Figs. 1—2. STEPHENSON, 1923, pp. 64—65, Fig. 20. AIYER, 1930, p. 21, Fig. 2 e. MICHAELSEN & BOLDT, 1932, p. 593.

Nais pectinata Stephenson. STEPHENSON, 1931 c, pp. 302—303, Pl. XVII, fig. 1.

Nais pectinata var. *ranauana* Boldt. MICHAELSEN & BOLDT, 1932, pp. 594—595, Fig. 1.

Dorsal setae 1—2 hairs, and 1—2 needles, pectinate, with 1—4 long intermediate teeth, connected by a webbing, proximal prong usually longer than distal; ventral setae 4—6 per bundle, in II—V somewhat thinner and straighter than the rest, with slightly proximal nodulus, and distal tooth slightly longer than proximal; those following with slightly distal nodulus, and teeth equally long. Transverse vessels in II—V forming a plexus; from VI on in a number of segments a pair of transverse vessels on the anterior face of each septum; dorsal vessel ventrally to the left; clitellum in $^1/_2$ V—VIII, absent between male pores; spermathecal ampulla large, roundish, duct thick; male funnels large, vasa deferentia short, thick, making a single bend; atrial ampulla ovoid, duct well defined; penial setae 4—6 per bundle, usually with a simple hook. $s = 40—95$. $l = 8—18$ mm.

S. Asia, Africa, S. America.

As this form occurs in the same regions as *A. pectinata*, and even in the same localities (STEPHENSON, 1911), it cannot be maintained as a "geographical race." The separation as a species is fully justified by the great differences in the vascular system and also by the shape of the needle setae (the clitellum is absent round the male pores in the present species, according to MEHRA, 1920, but judging from CHEN's figure not in *A. pectinata*). — The anterior ventral setae are stated to be 60—105 μ long, the rest 60—93 μ, the needles 67—112 μ, the hairs 100—332 μ.

Nais pectinata Stephenson of STEPHENSON (1931 c) seems to belong to the present species. The needles approach in shape those figured by S. (1911) for the present species much more than *A. pectinata*, having long teeth (7—9 μ long, judging from his Pl. XVII, fig. 1), only faintly diverging, against the strongly diverging, not more than 3.5 μ long prongs of *A. pectinata*. STEPHENSON's reason for placing the specimens in *A. pectinata* is

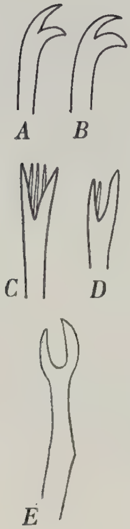

Fig. 21. *A-D Allonais inaequalis.* "*Ranauana*"-form, distal ends of setae. *A* ventral seta of II, *B* of a posterior segment, *C, D* needle setae. *E Allonais chelata.* Distal end of needle seta (from Marcus, 1944). *A-D* 1200 ×. *E* c:a 1500 ×.

the size and number of their ventral setae, which are smaller than is usual in *A. inaequalis.* ($s = 22$—31, ventral setae 2—4 per bundle, 53—60 μ long). The present species is, however, so vastly variable with respect to these characters that a widening of its range of variation through a new finding seems quite natural. S. also argues that the distal prong of *A. inaequalis* is much shorter than the proximal, while in the specimens referred to it was only slightly shorter; such a character seems, however, to be bound to vary.

Nais pectinata var. *ranauana* Boldt seems to be rather such a variant of *A. inaequalis,* than anything with systematic significance. It was found together with the latter ("Sawah nahe Ranau"), so it cannot be a geographical race of this, and the needle setae definitely bring it nearer to *A. inaequalis,* not to *A. pectinata,* as Boldt himself points out. The formation of a new species for it seems rash, as practically nothing but the setal characters are known, and they agree very well with those of *A. inaequalis,* except that the two prongs of the needles are usually equally long. I found it several years ago in a sample from Lome in Togo, from the collection of the Zoological Museum of Berlin, but unfortunately I examined only the setae. Below are the measurements from one specimen:

	v. s. II	v. s. VI–post.	n. s.	h. s.
number	3–4	3–7	1–2	1
length	68	59–65	65–74	220–230
thickn.......	1.5	2.5	2.5	

The distal tooth of the ventral setae was longer in II—V (Fig. 21 *A*), and equally long in the rest (Fig. 21 *B*). The prongs of the needles were usually about equally long (7.5—9 μ), but often one or the other was longer (Fig. 21 *C, D*). It was not possible to make out whether there was a webbing between them. — $s = 28$—38.

Allonais paraguayensis (Michaelsen, 1905).

Dorsal setae beginning in VI or VII, 1—2 hairs per bundle, and 1—2 needles, bifid, with long teeth, the proximal being about twice as long as the distal, the distal occasionally bifid; ventral setae 2—6 per bundle, all about equally long, or shorter in the anterior segments; in the latter slightly thinner, with nodulus median or distal, and distal tooth usually slightly longer; in the rest nodulus distal, and teeth equally long. Vascular system in anterior segments forming a plexus. In one form 6 segments formed anteriorly on asexual reproduction.

Allonais paraguayensis paraguayensis (Michaelsen, 1905).
(= *Nais paraguayensis* Michaelsen).
Fig. 28 *B*.

Nais paraguayensis MICHAELSEN, 1905 a, pp. 354—355.

Nais paraguayensis Michaelsen. MICHAELSEN, 1905 b, pp. 306—307; 1909 b, p. 131. STEPHENSON, 1909 a, pp. 263—264, Pl. XVII, figs. 22—24; 1920, p. 197, Pl. IX, fig. 1; 1921, pp. 750—751; 1923, pp. 61—62, Figs. 15—16; 1931 c, pp. 301—302. MICHAELSEN & BOLDT, 1932, p. 592. HYMAN, 1938, pp. 126—143. MARCUS, 1943, pp. 23—29, Pl. II, figs. 11—12, Pl. III, Figs. 9—10, 13.

[?] *Nais paraguayensis* var. *aequalis* STEPHENSON, 1920, pp. 197—198, Pl. IX, fig. 2.

[?] *Nais paraguayensis* var. *barkudensis* STEPHENSON, 1921, pp. 751—752, Pl. XXVIII, fig. 1.

[?] *Nais paraguayensis* var. *aequalis* Stephenson. STEPHENSON, 1923, pp. 62—63, Fig. 17; 1924, p. 321; 1931 a, p. 265; 1932, p. 231. MARCUS, 1944, p. 51, Pl. IX, fig. 38.

[?] *Nais paraguayensis* var. *barkudensis* Stephenson. STEPHENSON, 1923, p. 63, Fig. 18. MICHAELSEN & BOLDT, 1932, p. 593.

Nais paraguayensis f. typica Michaelsen. STEPHENSON, 1931 a, p. 265. CHEN, 1940, pp. 36—39, Fig. 7. MARCUS, 1944, p. 50.

Dorsal setae from VI onwards, needles with nodulus, distal end straight, proximal tooth being twice as long as, and thicker than distal, which may be bifid. Clitellum in V—VIII, absent between male pores; spermathecal ampulla ovoid, duct fairly short, well-defined; atrial ampulla round, duct well-defined; penial setae present, 3—11 per bundle, with a simple hook. 5 segments produced at anterior end. $n = 24—46$. $s = 15—200$. $l = 4—60$ mm. Swims with transverse movements, rotating round its axis.

S. and E. Asia, S. and N. America.

This race of the species is extremely variable with regard to size of body and setae; the degree of difference in shape between the ventral setae of II—V and the rest may also vary strongly. The length of the setae as stated in the literature is: ventral setae 55—123 μ, needles 60—192 μ, hairs 200—500 μ. MARCUS (1943) reports: "the commissures of the anterior segments anastomose, forming a plexus" (transl.), but it is not stated whether any simple commissural vessels are present, too. CHEN figures the clitellum as present round both the male and the spermathecal pores; his pictures are, however, not always reliable in this respect, and he never mentions anything about it. In the pictures in MARCUS (1943) it seems to be absent (cf. Fig. 28 *B*, p. 253). M. reports a lateral position for the spermathecal apertures; the atria open on projections.

Nais paraguayensis var. *aequalis* Stephenson (1920) is reported to have needles 52 μ long, 2.5 μ thick (in *A. parag. parag.* 4—7 μ), with equally long teeth, and ventral setae 52 μ long, all about equal, with teeth equally long. It cannot possibly be a geographical race, being found in S. and E. India and S. America, where *A. p. p.* also occurs (also in E. Africa), but it is too imperfectly known to allow of any conclusion as to its taxonomic value. Its setae seem to resemble rather more those of *A. gwaliorensis*. MARCUS reports it from Brazil. He states, however, that the ventral setae of II—V differ considerably from the rest, being 80 μ long against 50—60 μ, thinner, and with the distal tooth longer. Possibly both are occasional modifications of *A. paraguayensis paraguayensis*.

Nais paraguayensis var. *barkudensis* Stephenson (1923), from India, is reported to have dorsal setae from VI, 2—3 hairs per bundle, about 250 μ long, and 2—3 needles, 94 μ long, bifid, with short teeth, distal tooth longer; ventral setae of II—V, 4 per bundle, about 100 μ long, 3 μ thick, with nodulus proximal, and distal tooth twice as long as proximal; those following 4—5 per bundle, 90 μ long, 3 μ thick, with nodulus strongly distal, and teeth equally long. *l* (preserved) probably about 5 mm.

This cannot be supposed to be a geographical race of *A. paraguayensis*, its range of distribution being contained within that of the latter. The only characters known, those of the setae, make it fairly probable that the form represents a separate species; future investigation will no doubt clear the matter.

Allonais paraguayensis aequatorialis (Černosvitov, 1938).

Dero (*Aulophorus?*) *paraguayensis* (Michaelsen) var. *aequatorialis* ČERNOSVITOV, 1938 b, pp. 270—274, Figs. 3—10.

Dorsal setae from VII onwards, 1—2 hairs, and 1—2 needles without nodulus, with distal end strongly bent and proximal tooth much longer and stouter than distal; ventral setae of II—VI slightly thinner than the rest. Anterior 6 segments strongly shortened; pharynx in II—VI. *s* = 47—58. *l* (preserved) = 4—8.5 mm. 6 anterior segments formed on regeneration.

E. Africa (Kenya).

The peculiar form of the needle setae, and the formation of 6 anterior segments on regeneration distinguish this form from the common one of *A. paraguayensis*, of which it may be a local race, as far as the facts are known. ČERNOSVITOV is of the opinion that it belongs to *Dero* (see discussion, p. 208). — The ventral setae are stated to be 100—120 μ long, the needles 116—135 μ, with teeth $\frac{6\text{—}7\ \mu}{12\ \mu}$, the hairs 170—420 μ.

Allonais chelata (Marcus, 1944).

Fig. 21 *E*.

Nais paraguayensis forma *chelata* MARCUS, 1944, pp. 51—52, Pl. X, fig. 39.

Dorsal setae from VI on, 1—2 hairs, and 1—2 needles, bifid, with nodulus strongly distal, and prongs curved, about equally long; ventral setae of II—V slightly longer than the rest, finer, with teeth equally thick and nodulus median, in the posterior segments distal tooth thinner, and nodulus distal. Anterior vascular plexus; in most other segments a transverse loop. $s = 50—115$. l (preserved) = up to 15 mm.

S. America (Brazil).

The anterior ventral setae are stated to diminish in length from 110 μ in II to 95 μ in V; the rest are 90—95 μ long, the hairs 120—150 μ, the needles 55 μ with teeth about 4 μ.

The peculiar form of the needles (Fig. 21 *E*, p. 202), and the numerous commissural loops, seem to justify the erection of a new species; there seems to be no reason why it should be a form of *A. paraguayensis*, and it cannot possibly be a geographical race.

Allonais gwaliorensis (Stephenson, 1920).

(= *Nais gwaliorensis* Stephenson).

[?] *Nais fusca* CARTER, 1858, pp. 20—30, 90—104, Pl. II—IV, figs. 1—30.
[?] *Nais fusca* Carter. VAILLANT, 1890, p. 374. BOURNE, 1891, p. 344.
Nais gwaliorensis STEPHENSON, 1920, pp. 198—199, Pl. IX, figs. 3—4.
Nais gwaliorensis Stephenson. STEPHENSON, 1923, pp. 59—60, Fig. 14. MICHAELSEN & BOLDT, 1932, p. 592. CHEN, 1940, pp. 35—36, Fig. 6.

Dorsal setal bundles with 1—2 hairs, and 1—2 double-pronged needles, with distal tooth slightly longer and straighter than proximal; ventral bundles of II—V containing 3—5 setae, with nodulus about median, and distal tooth slightly longer than proximal; in the following segments 4—6 setae per bundle, somewhat shorter and thicker, with distal nodulus, and teeth equally long. Clitellum in V—VIII, weaker but not absent round male pores; spermathecal ampulla ovoid, duct thick; vasa deferentia slightly curved; atria round or ovoid, duct inconspicuous; no penial setae. $s = 25—59$. l (living) = 4—12 mm, (preserved) = 2.7 mm.

E. and S. Asia.

The anterior ventral setae are stated to be 50—80 μ long, the rest 45—60 μ, the needles 45—56 μ, the hairs 200—250 μ.

The sexual organs were briefly described by CHEN (1940). There are no accounts of the vascular system.

It seems fairly probable that *Nais fusca* Carter belongs to this species. His interpretation of the sexual organs is far from correct, but from his Pl. II, fig. 3 their shape may be judged. There are no eyes, no stomachal dilatation, no budding-zone (s apparently = 38, l = 5 mm), and coelomocytes are present. The dorsal setae in the specimens with clitellum begin in VIII, thus probably normally in VI. They are stated to consist of 1 long hair, and 2 shorter; one of the latter obviously will be a needle, simple- or double-pronged, as older authors seldom noticed the existence of teeth. The ventral setae are 4 per bundle. There are spermathecae ("testes") in V, with a bag-like ampulla, and short duct; vasa deferentia ("Fallopian tubes") joining the atria at the anterior face, and a large atrial ampulla ("oviduct"), with a short duct. Obviously there are no prostate gland cells, and no penial setae. The paired condition of the sperm- and egg-sac in the picture will no doubt be due to a misunderstanding. Two points seem to make the assignment to this genus somewhat doubtful, namely the entrance of the vasa deferentia into the anterior side of the atria, instead of immediately above the duct, but this may be due to inaccuracy in the drawing, and the statement that the blood is red, while in *Allonais* it is, as far as is known, more yellowish. This character would speak in favour of a *Dero* but CARTER seems to have investigated hundreds of specimens and not found any trace of gills. The blood colour in *A. gwaliorensis* is not known. Among the species of *Allonais* which may be regarded in this connection, *A. gwaliorensis* is the only one without penial setae; on the other hand, these may have been over-looked by CARTER.

Allonais pectinata (Stephenson, 1910).
(= *Nais pectinata* Stephenson.)

Nais pectinata STEPHENSON, 1910 b, pp. 236—237, Pl. XI, fig. 1.
Nais pectinata Stephenson. STEPHENSON, 1920, p. 198; 1923, pp. 63—64, Fig. 19. AIYER, 1930, pp. 19—20, Fig. 2.
[*non*] *Nais pectinata* Stephenson. STEPHENSON, 1931 c, pp. 302—303.
? *Nais pectinata* Stephenson. STEPHENSON, 1932, pp. 229—231, Fig. 1.
Nais denticulata CHEN, 1940, pp. 39—41, Fig. 8.

Dorsal setae 1—2 hairs and 1—2 needles per bundle, needles pectinate, with 1—5 intermediate teeth, nodulus $^1/_5$—$^1/_3$ from the distal end; ventral setae of II—V 3—5 per bundle, with distal tooth slightly longer than proximal, and nodulus slightly proximal; those following 2—7 per bundle, thicker, with nodulus distal, and teeth equally long. Dorsal vessel to the left; 4 pairs of transverse commissural vessels, in II—V. Clitellum in $^1/_2$ V—$^1/_2$ VIII; spermathecal ampulla round, duct distinct; vasa deferentia almost straight; atrial ampulla globular, duct well-defined; penial setae present, 3—5 per bundle, with a simple hook, occasionally with a vestigial distal prong. n (on fragmentation) = 20—23. s = 15—65. l = 1.5—8 mm.

India, China, Abyssinia.

Nais denticulata Chen certainly belongs here, as the setal characters wholly agree, CHEN's measurements only being slightly lower. The sexual organs have been described chiefly by CHEN.

The specimen put by STEPHENSON (1932) with hesitation into this species fits in very well, so that there seems to be no need for doubt as to the identity. — For *N. pectinata* of STEPHENSON (1931 c) see p. 201.

The length of the setae is stated to be: hair setae 70—220 μ, needles 42—68 μ, with prongs 3.5 μ, ventral setae of II—V 56—65 μ, the rest 51—58 μ long, 2 μ thick. The penial setae, according to CHEN are 53—68 μ long.

*

There are three species of *Allonais* which seem to be fairly closely related to each other, viz. *A. inaequalis*, *chelata*, and *paraguayensis*. They have a vascular plexus in the anterior segments, and at least the two first-mentioned also have additional loops in a number of the segments. Also, the needle teeth are remarkably long, straight in *A. inaequalis* and *paraguayensis*, and curved in a peculiar manner in *A. chelata* (which was described as a form of *A. paraguayensis*). The sexual organs are fairly well described and apparently similar in *A. inaequalis* (MEHRA, 1920) and *paraguayensis* (CHEN, 1940; MARCUS, 1943). Judging from the figures, the clitellum is absent between the male pores, and the atrial epithelium seems to be glandular in the latter species, at least, judging from CHEN's figure (from MEHRA's figure of *A. inaequalis* no conclusions can be drawn).

A. gwaliorensis is imperfectly described, thus nothing has been reported about the vascular system, so that its relations to the other species of the genus cannot be estimated with sufficient certainty. Its needle setae have short teeth, and the clitellum seems to be present between the male pores, though less glandular here than elsewhere (CHEN, 1940). The genital apparatus seems otherwise to be very similar to that of the above-mentioned species, except that the atrial epithelium in CHEN's figure is very thin, so that it can hardly be glandular.

A. pectinata, too, has short needle teeth (though with intermediate teeth), the clitellum seems to be present between the male pores, though it is less glandular ventrally, and the atrial epithelium seems to be very low (CHEN, 1940), so in these respects it resembles *A. gwaliorensis*. The vascular commissures in the anterior segments are simple, and no additional vessels occur. Thus it seems that this species is not especially closely related to *A. inaequalis-chelata-paraguayensis*; very probably it ought to be put into a different, new genus, possibly together with *A. gwaliorensis*. As it is desirable, however, to first know more about the species in question, I have thought it better not to do so yet, but have provisionally ranged them with *Allonais*, which genus they seem to resemble most.

ČERNOSVITOV (1938 b), who refers *A. paraguayensis* to *Dero*, in analogy with *D. malayana*, assumes it to have normally a branchial fossa with gills, though these should seldom have a chance to develop properly, on account of the frequent regeneration of posterior segments after fragmentation. This seems not to be so probable, the various authors who have investigated the species never having found any trace of gills. Č. also refers to the fact that among *Dero* gill-less specimens often occur, with an imperfectly regenerated posterior end; in this case, however, it is always an occasional abnormality, and gill-bearing specimens are found among the gill-less ones. Č. also mentions other characters in the species, suggestive of *Dero*: "D'abord nous mentionnerons l'absence des yeux, la forme de la tète pourvue d'un petit prostome acuminé et dirigé vers le haut, les premiers segments légèrement élargis, un grand pharynx se transformant progressivement en intestin, ainsi que la position de l'anus sur la face dorsale du corps, ce que nous n'observons pas chez les répresentants du genre *Nais*." He is undoubtedly right that it is difficult to put it into *Nais*, but I think the solution given in the present paper is more rational than transferring it into *Dero*.

Genus **Stephensoniana** Černosvitov, 1938.

Generic type: *Stephensoniana trivandrana* (Aiyer).

No eyes. Dorsal setae from II onwards, hairs and straight, simple-pointed needles; ventral setae all of one type. No coelomocytes. Sexual organs one segment in front of the usual situation; atria provided with prostate gland cells; penial setae present. 4 segments formed at anterior end on budding.

Stephensoniana trivandrana (Aiyer, 1926).

Fig. 28 *C*.

Naidium(?) trivandranum Aiyer, 1926, pp. 139—141, Pl. V, VI.
Stephensonia trivandrana (Aiyer). Aiyer, 1930, pp. 27—29, Fig. 7, Pl. I, figs. 2—4.
Stephensoniana trivandrana (Aiyer). Černosvitov, 1938 a, pp. 539—541, Figs. 1—4.

Body-wall with cutaneous glands, foreign matter adhering. Dorsal setal bundles containing anteriorly 3—4 hairs, and 3—4 needles, suddenly tapering towards the distal end, posteriorly 1—2 hairs and needles; ventral setae anteriorly 4 per bundle, decreasing to 1 posteriorly, all with proximal nodulus, and distal tooth longer than proximal, the difference between the teeth growing stronger backwards. Pharynx in II—part of III; in VI a sudden dilatation of the gut (stomach?). Dorsal vessel situated to the left of the gut as far forwards as IV; 1 pair of contractile vessels in IV. Clitellum in $^1/_2$ IV—$^1/_2$ VI; spermathecae small, ampulla spherical or oval, duct distinct; vasa deferentia apparently devoid of prostate, atria small, pear-shaped, with thick, glandular epithelium, opening directly outwards; penial setae 4—5 per bundle, with distal nodulus and two blunt, short prongs. $n = 20$. $s = 21$—43. $l = 2$—6 mm.

India, Palestine.

The length of the hair setae according to the authors is 120—145 μ, the needles 38—50 μ, the ventral setae 67—90 μ. The species is stated to have no stomach; there is, however, an abrupt dilatation in VI—VII, which closely resembles a stomach. The arrangement of the vascular loops in the anterior 3 segments is not known. AIYER does not record whether the clitellum is absent or not between the male pores, and neither did he see the openings of the vasa deferentia into the atria (cf. Fig. 28 *C*, p. 253).

Subfamily *Pristininae* Lastočkin, 1924.

Prostomium often forming a proboscis. No eyes. Dorsal setae usually beginning in II, consisting of hairs and needles. Pharyngeal and septal glands present; stomach of special structure, with intra-cellular canals. Commissural vessels mostly only in preovarial segments. Coelomocytes present. Nephridia sometimes invested with bladder-like peritoneal cells. Testes and spermathecae in VII, ovaria and atria in VIII. 7 segments formed at anterior end, by budding.

Genus **Pristina** Ehrenberg, 1828.

Generic type: *Pristina longiseta* Ehrenberg.

Dorsal setae hairs and simple, bifid or trifid, needles, with or without a nodulus. Dorsal vessel in the middle-line; commissural transverse vessels simple, anastomosing, or forming a plexus. Stomach, beginning in VI, VII, or VIII. Chloragogen beginning in IV or V. Vasa deferentia with or without prostate cells joining atria on top; atria without prostate, most often weak, tubular; genital setae of various shapes, often accompanied by special glands.

Pristina rosea (Piguet, 1906).

Fig. 22 *A*.

Naidium roseum PIGUET, 1906, pp. 223—225, Pl. IX, figs. 22—23.

Naidium roseum Piguet. PIGUET, 1909, pp. 175—176, Pl. III, fig. 18. PIGUET & BRETSCHER, 1913, pp. 25—26.

Pristina rosea (Piguet). MICHAELSEN, 1909 a, p. 28, Fig. 47. SCHUSTER, 1915, pp. 50—51, 76—77. SVETLOV, 1924, p. 197. MALEVICH, 1927, p. 9. UDE, 1929, pp. 30—31, Fig. 29.

[*?*] *Pristina lutea* (Schmidt). SVETLOV, 1924, pp. 197—198.

[*? non*] *Pristina rosea* (Piguet). MICHAELSEN & BOLDT, 1932, pp. 596—597. KONDÔ, 1936, pp. 386—387, Pl. XXIV, fig. 16.

[*non*] *Naidium roseum* Piguet. MARCUS, 1943, pp. 130—131, Pl. XXV, fig. 105, Pl. XXVI, fig. 106.

No proboscis. Hair setae very finely serrated, 1—2 per bundle, needles 1—2 per bundle, slightly curved, with nodulus slightly distal, and moderately long, fine teeth, the distal being shorter than the proximal; ventral setae increasing in length posteriorly in the first segments, all with nodulus slightly distal, and distal tooth longer than proximal, the difference growing smaller towards the rear. Stomach beginning in VII or VIII; septal glands in III—V or IV—VI. Transverse commissural vessels in I—III forming a net-work, in IV—VII simple. $n = 16$—18. $s = 21$. $l = 4$—5.5 mm.

Europe.
Sweden: Ryggmossen.

I found only one specimen, a double chain, about 3.3 mm long (preserved); $n = 18$. The living animal was rose-coloured. The setae could not be measured exactly, but the ventral were about 35—48 μ long, the needles 52—58 μ long, with teeth about $\frac{1.8\ \mu}{3.3\ \mu}$, and the hairs 130—270 μ. I could not, in contrast to Schuster, make out any serration in the latter. The difference in length between the needle teeth was larger than in Piguet's figures (cf. Piguet, 1906, Pl. IX, figs. 22, 23), otherwise they resembled the figures fairly closely, especially his fig. 22, the teeth in fig. 23 being too parallel, and too finely pointed, and the difference in thickness somewhat exaggerated. The measurements found in the literature are: ventrally in II 46 μ, in III 47 μ, in the rest 48—60 μ, needles 39—69 μ, hairs 118—237 μ.

The stomach in my specimen is situated in VII—VIII, the dilatation being slow. The ventral wall is slightly thickened, otherwise the wall is fairly thin. I have not been able to determine with certainty whether there are any intracellular canals. Septal glands are present in IV—VI and are high.

The vascular system in the anterior segments conforms with the description of Piguet (1906). In I—III it constitutes a close net-work; in IV—V there are free, winding loops, in VI a short one, and in VII one attached to the anterior face of the septum 7/8 (Fig. 22 *A*, p. 214).

The first nephridium is situated in IX.

As to *Pristina rosea* (Piguet) of Michaelsen & Boldt (1932) and Kondô (1936), and *Naidium roseum* Piguet of Marcus (1943) see pp.224,225.

Several authors (e. g. Piguet, 1906, Michaelsen, 1909) have suggested the possible identity of the present species with *Naidium luteum* Schmidt (1847). This is, however, excluded on the following reasons: About the new genus *Naidium* Schmidt states: "Die Gattung *Naidium* ist der *Nais* am nächsten verwandt: lang gestreckt, vorn zugespitzt, hinten abgestumpft; die Oberlippe ist kurz. Der Hauptcharakter ist der, dass die vier Borstenreihen ihren Anfang zugleich auf demselben (undeutlichen) Körpersegmente, dem dritten, nehmen. Sämmtliche Borsten sind Hakenborsten, mit denen zugleich jedoch bei der einen Art die sonst gewöhnlichen Rückenborsten wachsen können. Augen sind nicht vorhanden. — In Bezug auf die Gleichheit der oberen und unteren Borsten steht die Gattung der *Nais uncinata* Oersted (Kröger Naturhistorisk Tidsskrift Bd. IV.) am nächsten."

Schmidt describes two species, *N. luteum* and *breviceps*. The latter is certainly an Enchytraeid, as has already been pointed out by VEJDOVSKY (1884, p. 23). About *Naidium luteum*, SCHMIDT states: "Die Haken, in allen vier Reihen an der Zahl ungefähr zwischen drei und fünf, sind von der gewöhnlichen Form, also etwas gebogen, in der Mitte eine Art Knie bildend, am Ende in zwei Spitzen verlaufend, von denen namentlich die obere rückwärtz gekrümmt ist. Zwischen den Haken des Rückens finden sich auch, aber nicht immer, von derselben Muskelscheide umgeschlossen, die Haarförmigen Borsten. Das Gefässblut ist charakteristisch rotgelb, wenn man es nicht in einer zu dünnen Schicht sieht, wodurch es natürlich ein blasseres Aussehen erhält. Die Magenähnlichen Erweiterungen des Darmes beginnen hinter der dritten Querreihe der Haken. — In ihrer Lebensart gleicht diese Species der blinden Naide MÜLLERS, indem sie, wie diese, beständig mit dem Kopfe und dem halben Leibe im Schlamme steckt, während der Schwanz in einer fortwährend schlängelnden Bewegung ist, gleich der, wodurch viele Insektenlarven ihren Kiemen frisches Wasser zuführen. Bei der geringsten Störung zieht sie sich schnell ganz in den Schlamm hinein, in welchem sie sich Röhren und Gänge bildet. So fand ich sie zu Tausenden in seichten, vom Vieh täglich besuchten Teichen, und es muss daher fast unglaublich scheinen, dass diese Naide bisher der Aufmerksamkeit der Zoologen entgangen sein sollte." From the above description it is apparent that it has not been made from a *Pristina*, nor from any Naid at all, but from some common *Tubifex*, probably *T. tubifex*, which is often found in shallow ponds, and in the needles of which the intermediate teeth are easily over-looked.

Therefore as the name *Naidium* was given by its author to a Tubificid (*N. luteum* stands first), it cannot be used as a generic name in the *Naididae*, and as the name *Naidium luteum* is certainly synonymous with another name, which has priority, it must be wholly rejected, according to the rules of nomenclature.

The question then arises as to what the organism which later authors have reported as "*Naidium luteum*" really is. The first one to use the name was VEJDOVSKY (1883, p. 219; 1884, pp. 31—32, Pl. III, figs. 7—13). He describes it as follows, (1884, loc. cit.): "Die unter diesem Namen von O. SCHMIDT aufgestellte und seit 1847 von anderen Forschern nicht beobachtete Art fand ich in grosser Anzahl, aber nur im geschlechtslosen Zustande in den Torfmoorwässern bei Marienbad, in Gesellschaft mit *Limnodrilus*, *Nais elinguis* und *Aeolosoma Ehrenbergii*. Sie wühlt meist im Schlamme und kommt nur gelegentlich auch im freien Wasser vor. Ihre Länge beträgt etwa 15 Mm; ein Einzelindividuum besteht aus 24—30 Segmenten. In Bezug auf den ganzen Körperhabitus erinnert *Naidium* an einen *Tubifex* von gelblicher oder schwach roter Farbe. — Der Kopflappen ist lang ausgezogen, mit seitlichen, schwachen Läppchen (Taf.

III. Fig. 7.). Augen fehlen. Die Borsten beginnen bereits am zweiten Körpersegmente sowohl auf der Bauch- als Rückenseite. Die Rückenbündel (Taf. III. Fig. 9.) bestehen aus je einer langen Haarborste (selten trifft man hier und da 2 Haarborsten) und einer kürzeren geraden, oder stark hakenförmig (Fig. 10.) gekrümmten Spaltborste. Die Bauchborsten (Fig. 12.) sind sämmtlich gekrümmte, gleichzähnig gegabelte Hakenborsten, zu 5—6 in einzelnen Bündeln. Der Pharynx nimmt das ganze 2. Körpersegment in Anspruch, der Oesophagus verlauft durch das 3., 4. und 5. Segment, die magenartige Anschwellung befindet sich im 7. Segment. Die deutlichen Septaldrüsen im 4., 5. und 6. Segment. Das Gehirn (Taf. III. Fig. 13.) ist mächtig entwickelt mit zwei grossen vorderen und zwei hinteren Lappen. Die letzteren entsenden wieder kleinere Läppchen, an denen die cerebralmuskeln inserieren. Das Blut ist lebhaft roth, das Rückengefäss ist mit dem Bauchgefässe durch drei Seitengefässschlingen-Paare im 4., 5. und 6. Segment verbunden. — An den von mir untersuchten Exemplaren konnte man Spuren der Knospung und Theilung wahrnehmen."

This description and the figures seem to indicate that Vejdovsky, too, actually had a Tubificid before him, and V. himself points out the Tubificid-like appearance of the animals; this applies also to the rather large body-length, and, above all, to the complicated shape of the brain — this shape is quite foreign for a Naid, but strongly reminds one of that of a *Limnodrilus* for example, though the presence of hair setae excludes this genus. The "traces of budding and fission" may well have been traces of regeneration.

Most later authors give only Vejdovsky's description (Bourne, 1891; Beddard, 1895; Bretscher, 1900; Michaelsen, 1900, 1909 a, 1927 a; Ude, 1929). Michaelsen (1905 b) states about some specimens in a collection from Zanzibar only that the dorsal crotchets are "deutlich ungleichzinkig" in contrast to Vejdovsky, who states them to be "fast gleichzinkig." It is not easy to guess what M. may have had before him — possibly *Pristina rosea*, or *Pr. jenkinae*. Munsterhjelm (1905), Toivonen (1911; "small, poorly developed specimens"), Pointner (1914 b), and Wolf (1928) give only the name, and it is of course impossible to judge what they may have had before them. de Vos (1922) reports *Pr. lutea* from the lower Elbe and the Zuiderzee, but the characters given are exactly the same as those given by Vejdovsky — thus this will also have been a Tubificid. Svetlov (1924) reports both *Pr. rosea* and *Pr. lutea* from Perm. He states that the needles in II—VII resemble those of *Pr. rosea*, but nevertheless he does not consider the two species identical, only very closely related. He assumes "a transgression of variable characters between closely related but well differentiated species" (transl.). It is, of course, impossible to judge if this explanation is satisfactory, and whether S. really had two species before him. Neither, however, may be called *Pristina lutea*. Lastočkin seems somewhere, according to Svetlov, to be of the opposite opinion to him, but I have not been able to find this paper. Knöllner (1935) reports one specimen from brackish water in the Kiel Bay, which he refers with hesitation to *Pr. lutea*; about this see p. 217. Černosvitov (1938 b, pp. 276—277), at last, gives a description of a number of specimens from E. Africa (Omo). Among 16 specimens from several different localities none apparently showed budding. The ventral setae were all equally long (about 60 μ), and between the teeth of the needles an intermediate tooth was present in some cases. These characters strongly suggest that the worms really represented some Tubificid species.

Pristina menoni (Aiyer, 1930).

Fig. 22 *B—E*; Pl. XXI, fig. 3.

[*?*] *Naidium mosquensis* Udalicov, 1907.
[*?*] *Naidium heteroseta* Udalicov, 1907.
Naidium menoni Aiyer, 1930, pp. 21—23, Fig. 3.

No proboscis. Hairs 1—2 per bundle, non-serrated; needles 1—2 per bundle, stout, simple-pointed or with a small distal tooth, and with bayonet-shaped distal half; ventral setae 2—5 per bundle, increasing in length backwards in anterior segments, in II nodulus median, in the rest distal, in anterior segments distal tooth longer than proximal, in posterior segments equally long. Stomach beginning in VII, with intra-cellular canals; septal glands in III—V. Ventral vessel dividing in V; simple commissural vessels in II—VII, or those of II branching. $n = 20—28$. $s = 28$. $l = 7$ mm.

India, Russia?
Sweden: Trehörningen.

The hairs are stated by Aiyer to be 92—225 μ long, the needles 39—79 μ, the ventral setae 39—61 μ. Aiyer states that the canals in the stomachal cells branch; this needs investigation.

According to Marcus (1943, p. 126; examination scheme), the two species *Naidium mosquensis* and *N. heteroseta* Udalicov, the descriptions of which I have not seen, have simple-pointed needles, and all the ventral setae about equal. They may have belonged here, though it will be impossible to tell, as the descriptions are apparently unsatisfactory. The hair setae are stated to be all of the same length in *N. mosquensis*, which seems rather suspect, and shorter in II and III in *N. heteroseta*, but here they are about 5 times as long as the needles, which is considerably more than in *Pr. menoni*.

I have identified with this species two specimens from lake Trehörningen (on vegetation near the shore). Pl. XXI, fig. 3 shows a complete view of this animal. The colour is white, not very transparent. There is

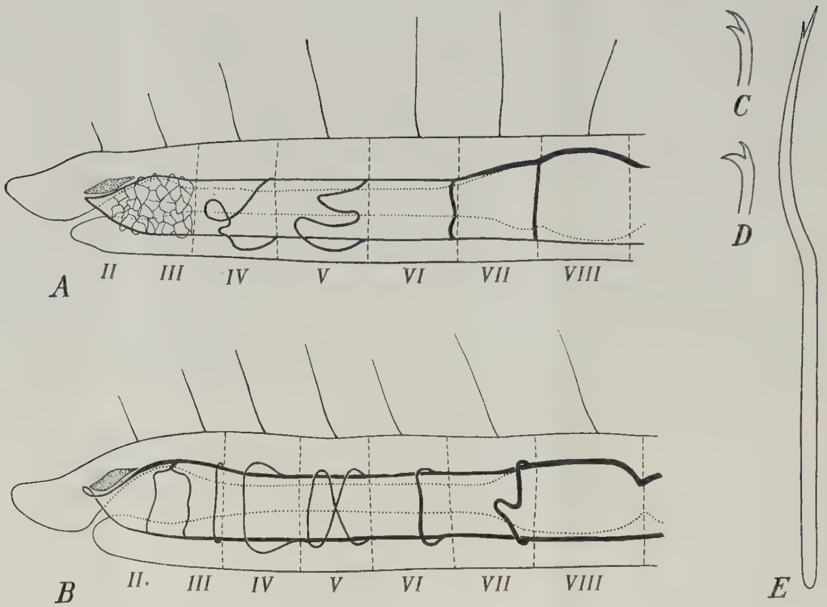

Fig. 22. *A Pristina rosea.* Vascular system of the anterior end, diagrammatic. *B-E Pristina menoni.* *B* Vascular system of the anterior end, *C* distal end of ventral seta from II, *D* from a posterior segment, *E* needle seta. *C-E* 1200 ×.

no proboscis, but the prostomium is somewhat elongated (in the figure it is not extended).

The hairs, mostly 2 per bundle, as far as I could make out, were smooth. The needles (Fig. 22 *E*), also usually 2 per bundle, at first appeared simple-pointed, very similar to those shown in Aiyer's picture, but examination in potassium acetate showed the existence of a very fine, short, distal tooth in at least some of the setae. The nodulus is slightly distal, and the distal part of the seta is fairly strongly curved. The ventral setae in II—VII are 4—5 per bundle, from VIII backwards 2—3 per bundle. Here, they are also slightly shorter than in the preceding segments, and the distal tooth is shorter than the proximal, while in II it is longer than, and in III—VII as long as the latter (Fig. 22 *C*, *D*). The following table shows the measurements in μ from one specimen:

	v. s. II	v. s. III	v. s. VII	v. s. VIII	v. s. post.	n. s.	h. s.
length	43–45	45–49	50–53	46–48	48	42–63	114–195
thickn.	1.4	1.3–1.4	1.4	1.4	1.4	1.7	1.3
teeth	$\frac{2.3\text{–}3}{1.8}$	$\frac{2\text{–}2.5}{2\text{–}2.3}$	$\frac{2.3}{2.3\text{–}2.5}$	$\frac{1.5\text{–}1.7}{2\text{–}2.5}$	$\frac{1.7}{2.5}$	$\frac{1.5}{3.5}$	

The ventral setae, and, as usual the hairs and needles, increase in length backwards in the first 3—4 seta-bearing segments.

The pharynx occupies II—III, and the dorsal diverticulum III. The oesophagus stretches through IV—$^1/_2$VII, the stomach beginning as a slow widening in VII, and reaching through VIII. The wall is not strongly thickened, and I could not make out with certainty any canals, though such are probably present. The stomach passes into the intestine through a short, very narrow part. There are three pairs of septal glands, in III—V, which are small, and bulky, and in IV and V they reach only about halfway up the septa. Chloragogen is present from V onwards. — According to Aiyer the dorsal vessel runs ventrally, to the left of the ventral vessel. This is fairly peculiar, for in the rest of the genus it is usually dorsal, and in my specimens it is situated dorsally, and slightly to the left in its whole course. It is united with the ventral vessel through free, simple, transverse loops in III—VII, and a branching loop in II (Fig. 22 *B*). The simple vessels all emerge immediately in front of the septa, make a longer or shorter loop forwards, and join the ventral vessel in front of the septa (cf. p. 39). The vessels in VI and VII as usual are stronger and more contractile than the rest.

The first nephridium is unpaired, and situated on the right side, with the funnels attached to the septum at a low point. The nephridium opens immediately in front of the right ventral setal bundle. Before the opening it is dilated to form a small end-bladder. The coelomocytes are round, about 7.5—8 μ in diameter.

The differences from Aiyer's description may be summarized thus: 1) The needles are bifid — Aiyer may, however, have over-looked the small distal tooth. 2) The distal tooth of the posterior ventral setae is shorter than the proximal. 3) The commissural vessels of II are bifurcate, and the dorsal vessel is dorsal. The differences are so small that I have judged it not wise to separate the forms, which may perhaps be geographical races. The species differs from *Pr. rosea* in the following characters: 1) The body colour. 2) The needles are more curved, and the distal tooth, when present, is relatively much smaller and more difficult to see. 3) The distal prong of the ventral setae is equally long as, or shorter, than the proximal in most segments. 4) There is no vascular plexus in I—III. The hairs also appear to be non-serrated, while they were stated by Schuster to be serrated in *Pr. rosea*. This difference, however, is not quite certain, as Piguet found no serration in *Pr. rosea*, and neither have I. On the other hand the hairs in *Pr. menoni* may be so finely serrated that Aiyer and I failed to see it.

Pristina bilobata (Bretscher, 1903).

[?] *Naidium uniseta* BRETSCHER, 1900, p. 15.
Naidium bilobatum BRETSCHER, 1903, pp. 11—12, Pl. I, fig. 1.
[?] *Naidium uniseta* Bretscher. PIGUET, 1906, pp. 216—217. PIGUET & BRETSCHER, 1913, pp. 26—27.
Naidium bilobatum Bretscher. PIGUET, 1906, p. 217, Pl. IX, figs. 24, 29. PIGUET & BRETSCHER, 1913, p. 27.
[?] *Pristina uniseta* (Bretscher). MICHAELSEN, 1909 a, p. 28. UDE, 1929, p. 32.
Pristina bilobata (Bretscher). MICHAELSEN, 1909 a, p. 28, Figs. 48—49. SCHUSTER, 1915, pp. 51, 76—77. UDE, 1929, p. 31, Figs. 30—31. ČERNOSVITOV, 1930, p. 9; 1938 a, p. 539.
[?] *Pristina sp.* MICHAELSEN, 1926 c, p. 3.
[?] *Pristina sp.* MALEVICH, 1927, p. 9.
[?] *Pristina lutea* (O. Schmidt)? KNÖLLNER, 1935, pp. 433—434, Fig. 5.

No proboscis. Hair setae serrated, 1—2 per bundle; needles 1—2 per bundle, bifid, with teeth short, equal, parallel; ventral setae 3—8 per bundle. Stomach beginning in VIII, slowly dilating. Commissural vessels in I—V forming a plexus. Posterior brain lobes deeply bifid (?). $n = 18—20$. $s = 34$. l (preserved) = about 4 mm.

Europe, Palestine, Turkestan.

The synonymy of this species is extremely uncertain. BRETSCHER's description is quite insufficient to characterize it, but PIGUET's figures make it certain that the needle teeth are equally long, apparently longer than in *Pr. foreli*, but shorter than the longer tooth in *Pr. rosea*. SCHUSTER added that the hair setae are serrated. ČERNOSVITOV (1930, and 1938 a) gives seta measurements of specimens from Turkestan and Palestine. In the former the ventral setae, 3—4 per bundle, are 30—38 μ long, the needles and hairs, 1 per bundle, 26—34 μ, and 42—108 μ long respectively. In the latter the ventral setae are stated to be 3—4 per bundle, 70—80 μ long, the needles 2 per bundle, the hairs 2—3 per bundle, about 300 μ long. MALEVICH (1927) gives as setal measurements of a *Pr. sp.* ("*lutea* or *bilobata*"): ventral setae 32—35 μ, needles 32—50 μ, hairs 83—138 μ, agreeing well with the Turkestan specimens. Thus, the species apparently varies very much in respect of its setal characters. The bilobation of the brain, a very remarkable feature, is not mentioned by anybody after BRETSCHER, and seems suspect.

It is impossible to know what *Pr. sp.* ("*lutea* or *bilobata*") of MICHAELSEN (1926 c), represents, but it may belong here.

Naidium uniseta Bretscher (1900) differs from *Pr. bilobata* (except in the brain character) only in the length of the hair setae, which are stated to be shorter than the diameter, while in the latter they are longer. This character is of course not reliable, and does not hold for *Pr. bilobata*, judging from ČERNOSVITOV's measurements (see above). The blood vessels in the anterior segments are stated to be sparse, but the curious statement that one loop runs from dorsally in II to ventrally in IV makes the passage suspect. It seems reasonable to assume that it is identical with *Pr. bilobata.* PIGUET (1906) reports that he has had the opportunity of studying BRETSCHER's original material of *Pr. uniseta* and *bilobata*, though he gives no characters of the former, but later (1928) he states that he has not seen the material of *Pr. uniseta*, and suggests dropping it altogether, which cannot be done according to the rules. What several authors, who have this species in their lists (WOLF, 1928; SCIACCHITANO, 1934; MALEVICH, 1937), actually had before them, is impossible to judge.

Possibly, *Pristina lutea* (O. Schmidt)?, recorded by KNÖLLNER, may also belong here. It was 6 mm long, with $n = 10$. The needles, 1—3 per bundle, have fairly long teeth (op. cit., Fig. 5 a); on comparison with PIGUET's figure they seem somewhat longer than in the latter. They are stated to be 50—73 μ long, and the hairs to be 110—160 μ. The ventral setae are stated to be only 1—2 per bundle, which seems very few. They are figured with a considerably longer proximal tooth (op. cit., Fig. 5 b), but in the text the teeth are stated to be almost equally long. It seems very possible that this specimen represents a new species, but among those known it apparently comes nearest to *Pr. bilobata.*

Nothing is known about the presence of canals in the stomachal cells in *Pr. bilobata.*

Pristina amphibiotica Lastočkin, 1927.

Fig. 23 *A*—*C*; Pl. XIX.

Pristina amphibiotica LASTOČKIN, 1927, p. 69, Figs. 1—2 [*fide* ČERNOSVITOV, *in litteris*].

No proboscis. Hair setae 1—2 per bundle, non-serrated; needles 1—2 per bundle, longer and thicker in IV (and V) than in other segments, bifid, with distal tooth much shorter than proximal, and nodulus distal; ventral setae 3—6 per bundle, with nodulus distal. In anterior segments distal tooth slightly longer than, or equal to proximal, posteriorly much shorter. Stomach in $^1/_2$VI—$^1/_2$VII, slowly dilating, with intracellular canals; septal glands in III—V. Anastomosing commissural vessels in II—V. Nephridia paired in IX, unpaired or missing in other segments. Coelomocytes numerous. Clitellum in $^1/_2$VII—$^1/_2$IX; no spermathecae; male funnels very small, vasa deferentia very short and narrow; no differentiated atria; probably no prostate; penial setae occasionally present, in IX, 1 per bundle, curved, with two enormous converging distal prongs; an ovisac formed; no sperm-sac. $n = 11$—12. $s = 12$—23. $l = 3$—6 mm.

Russia.

Sweden: Lövsjön (S. BERG coll.); Siljan, Åkerö tjärn.

I have not had access to LASTOČKIN's paper, but the description was given to me in a letter from the late Dr. ČERNOSVITOV. It appears that the same species occurs in Sweden, and as L.'s original description will probably not be accessible to most, I give a full account of the species.

Pl. XIX, fig. 1 shows a complete organism. The animals are not very transparent. In one locality (Bosviken, lake Siljan) I found it fairly abundant, together with small Enchytraeids of the same size, to which they were exceedingly similar in appearance as well as in behaviour. The prostomium is pointed, and the hinder end tapering.

The needles have a conspicuous nodulus at $^1/_3$—$^2/_5$ from the tip (Lastočkin: hardly conspicuous); the distal part is curved. The teeth are slightly diverging (Fig. 23 *C*), the proximal tooth being much longer than the distal. Their length in my material varied between about $\frac{1\,\mu}{1.8\,\mu}$—$\frac{1.5\,\mu}{2.8\,\mu}$. (According to L.'s Fig. 1, the distal prong is curved in the same direction as the proximal, not diverging.) In most segments the needles are 0.9—1 μ thick, but in IV they are nearly twice as thick, 1.6—1.8 μ, and also longer than the rest (according to L. they are larger also in V).

The ventral setae are about 1—1.3 μ thick in all bundles in my material, and not more numerous in IV—V, as in L.'s specimens. The teeth in the first segments are about $\frac{1.8\,\mu}{1.2\text{—}1.5\,\mu}$ (Fig. 23 *A*), posteriorly about $\frac{1\,\mu}{1.5\text{—}1.7\,\mu}$ (Fig. 23 *B*), except in the material from Lövsjön, where they were longer, about $\frac{2.4\,\mu}{1.6\,\mu}$ and $\frac{1.5\,\mu}{2.2\,\mu}$ respectively. (L. states that the distal tooth is shorter, but apparently he makes no distinction between anterior and posterior setae.) As to the setal length, the following table represents the measurements from 2 specimens:

	II	III	IV	V	VI	VII	VIII	IX	post.
v. s.	31–37 (31–33)	37–40 (32–38.5)	34–43 (32–37)	36–45 (36–40)	37–43 (34.5–40)	37–40 (34.5–38.5)	36–39 (33.5–38.5)	36–39 (32–38.5)	36–40 (32–42)
n. s.	33–34 (25.5–31)	40–45 (36–41)	45–52 (42–50)	39–40 (38.5–45)	39–40 (36–41)	39–40 (34.5–41)	39–40 (36–41)	39–40 (36–40)	39 (34.5–41)
h. s.	118 84.5–87.5)	104–130 115–143.5)	133–155 (125.5–138)	133–148 (133–149	110–140 (125–141)	110–140 (128–143.5)	125 (125.5–143.5)	120 (133)	111–150 (112.5–153.5)

These measurements agree extremely well with those given by L., which are printed below my own in the table.

The stomach, in contrast to all previous species, begins in VI, and dilates slowly. Its walls are thick, and the cells contain canals (Pl. XIX, figs. 2, 6, and the anatomical section, p. 27).

I could not make out the vascular system in the anterior end with confidence, but it seems to agree with L.'s description (cf. above). The dorsal vessel is mid-dorsal.

The distribution of the nephridia is as described by L., one pair in IX, unpaired in the posterior segments, usually alternating to the right and the left.

The coelomocytes are 9—12 μ in diameter.

I was fortunate in finding sexually mature specimens on two occasions. Dorsally the clitellum reaches from about the half of VII to the half of IX; ventrally, it is weak before the male pores, and absent between them. The testes, in VII (Pl. XIX, fig. 6) are about 30 μ high, 10 μ broad. I could not identify with certainty the ovaries. I have never found any traces of spermathecae, although I have examined a number of sectioned mature specimens, several with mature ova.

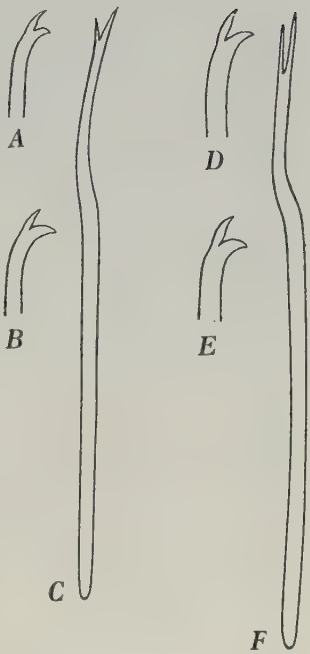

Fig. 23. *A-C Pristina amphibiotica*. *A* distal end of ventral seta from II, *B* from a posterior segment, *C* needle seta. *D-F Pristina idrensis*. *D* distal end of ventral seta from II, *E* from a posterior segment, *F* needle seta. 2000 ×.

The male funnels are situated on the front face of septum 7/8, very low down (Pl. XIX, figs. 4, 5). They are extremely small, only about 15—16 μ long, 10—11 μ in diameter at the opening. The wall is about 3 μ thick. The funnels pass into very short and narrow vasa deferentia, about 25 μ long, 6 μ wide, with walls 2 μ thick (Pl. XIX, fig. 4). It is hardly possible to speak about atria, but sometimes the distal part of the vas deferens is a little dilated, with a diameter of about 8 μ (Pl. XIX, fig. 5), which may correspond to the atrium, or the atrial duct. On account of the small size of the organs it is difficult to determine whether some of the scattered cells in the vicinity constitute a prostatic covering, but it is apparantly not so. The male pores lie immediately behind septum 7/8. In connection with them there is sometimes a penial seta on each side, but as I found them only in one specimen, kept as a setal preparation, and never in sections, I could not make out their exact position. They agree with the genital setae of *Pr. longiseta* and *breviseta*, having a strongly curved proximal end, and distally two enormously long prongs, converging at the tips, the proximal being finer and straighter (Pl. XIX, fig. 3). These setae are 51 —54 μ long, the teeth being 19—21 μ, but they are not much thicker than ordinary setae, about 1.5 μ. There is no nodulus.

In VIII, behind the vasa deferentia, two enormous "Teilovarien" are usually seen (Pl. XIX, fig. 4 *to*). They very closely resemble glandular masses, as they appear to open in connection with the male pores; there is, however, no opening, and they are attached to the ventral body-wall with something like a cornet of peritoneum. The same is the case with the gut, which is attached to the body-wall in the same manner, twice in each segment (Pl. XIX, fig. 4 *pe*). The egg-sac stretches into X. In several specimens IX has been filled, and strongly distended, by a large, mature ovum. No sperm-sac has appeared in any stage. Stages of sperm-cells were hardly ever seen. The only exception is in a specimen, where, behind the testes, some spermiocytes could be seen, arranged on the surface of a cytophore, as usual. — It is difficult to imagine how fertilization is achieved, but only two ways seem possible, both implying self-fertilization: either the sperm is conducted directly through the vasa deferentia to the ovum (whereby the pressure from the cocoon on being pulled off could possibly squeeze the sperm out), as there are no spermathecae to store it; this probably occurs in *Lumbriculidae* (Gavrilov, 1935). Or else some sort of internal self-fertilization may take place. This seems to be indicated by the rudimentary condition of the male efferent apparatus. As penial setae are only exceptionally present, they have probably lost their function. The possibility of the sperm being attached to the body-wall of the partner on copulation seems excluded, as I never observed any spermatophores. On the other hand, parthenogenesis is not excluded.

The mode of life of this species seems to vary considerably. Lastočkin found it "in Sphagnum of swamps and lakes not covered with water but only moisted." In the little lake, Åkerö tjärn, I found it only on the sides of an old wooden bridge, and it disappeared when this was taken away. In Lake Siljan the species lives in a couple of shallow bays, at a depth of some decimeters, in the surface layer of a sandy bottom.

Pristina idrensis sp.nov.

Holotype at the Museum of Natural History, Stockholm.

Fig. 23 *D—F*; Pl. XX, Pl. XXI, fig. 1.

Diagnosis: Colour whitish. No proboscis. Hair setae 1—2 per bundle, non-serrated; needles 1—2 per bundle, curved distally, with nodulus distal, bifid, and with teeth long and parallel, proximal prong slightly longer than distal; in IV needles longer and stouter than in other segments; ventral setae 3—7 per bundle, increasing in length backwards in anterior segments, with distal nodulus, and teeth in all segments equally long; in anterior segments setae and teeth finer than behind. Stomach in $^1/_2$VI—$^1/_2$VII, slowly dilating, with intra-cellular canals; septal glands in III—V. Dorsal vessel situated mid-dorsally. Nephridia in IX paired, posteriorly unpaired. Coelomocytes present. Clitellum in $^1/_2$VII—IX; no spermathecae; male funnels small, vasa deferentia short; atria very small, thin-walled, atrial ducts distinct, uniting before opening together mid-ventrally; no penial setae; ovisac formed; no sperm-sac. $n = 11—13$. $s = 14—18$. $l = 3—4$ mm.

Sweden. Several tarns about Foskros. 26 specimens.

This species closely resembles *Pr. amphibiotica*; thus, its size and form agree wholly with the latter (Pl. XXI, fig. 1), and so do the shape and situation of the stomach, the septal glands, and the nephridia.

The needles are largest in IV and V, as in *Pr. amphibiotica*, but their teeth are parallel, and much longer than in the latter, and the proximal tooth is only slightly longer (Fig. 23 *F*), the measurements being $\frac{3\ \mu}{3.7\ \mu}$ — $\frac{3.7\ \mu}{4.5\ \mu}$. The thickness of the needles is less than 1 μ in most segments, about 1.5 μ in IV. The nodulus is situated as in *Pr. amphibiotica*. The ventral setae are somewhat finer in the anterior segments, about 1.3 μ, against 1.6 μ in the posterior segments. Contrary to the state in *Pr. amphibiotica* they have equally long teeth throughout the body, about $\frac{2\ \mu}{2\ \mu}$, though the teeth are finer in the anterior segments (Fig. 23 *D*, *E*). — The following table gives setal measurements from 7 specimens:

	II	III	IV	V	post.
v. s.	32–39	35–42	38–45	39–42	38–42
n. s.	33–29	40–45	48–57	48–55	38
h. s.	110–130	135–130	150–200	170–185	180–190

I could not make out the vascular system in the anterior segments.

The sexual organs are better developed than in *Pr. amphibiotica*, though very small. The clitellum reaches somewhat farther back, over the whole of IX, and is absent round the male pores. The testes (Pl. XX, fig. 2), situated anteriorly in VII, are long, about 40 μ, and slender. The spermathecae are absent in this species, too.

The male funnels are better developed, and cup-shaped (Pl. XX, fig. 3), 15—16 μ long, 13 μ wide, with walls 3—4 μ thick, and strongly ciliated. They are situated low down, and pass into the vasa deferentia (Pl. XX, fig. 4), which are about 40 μ long, 6.5 μ wide, with walls 2 μ thick. The atria are more conspicuous than in *Pr. amphibiotica*, being 17 μ long; the diameter is only 6.5 μ, like that of the vasa, but the walls are very thin, so that the lumina are considerably wider. The atria incline obliquely outwards, their distal ends converging; the atrial ducts, 13 μ long, meet in the median line, join each other, and have a common opening (Pl. XX, fig. 5). About prostate cells, the same applies, as in *Pr. amphibiotica*. I found no penial setae, but as I had only 4 mature specimens against 10 in *Pr. amphibiotica*, it is possible, that they may occur occasionally in this species, too.

Behind the atria "Teilovarien" are attached as in *Pr. amphibiotica*. The ovisac reaches into X, and here, too, it often contains a ripe ovum, so large that the whole body in this region is distended and swollen, and the intestine is pressed against the wall. No sperm-sac is formed in this species either, and sperm-formation is very sparse. The remarks on the mode of fertilization in *Pr. amphibiotica* also apply here (p. 220).

The mode of life of this species is reminiscent of that described by Lastočkin for *Pr. amphibiotica*; the animals live in moss-tufts which hang down into the water from the border of little woodland lakes, together with *Nais variabilis* and *communis*, *Chaetogaster cristallinus* and *langi*, and *Vejdovskyella comata*.

The species is no doubt very closely related to *Pr. amphibiotica*, and probably it originally represented an alpine form of the latter. Possibly the differences have been maintained by self-fertilization, or parthenogenesis; in that case the forms can hardly be regarded as species. At our present state of information, however, the differences in the appearance of the needles and ventral setae, and the sexual organs, seem large enough to justify the erection of a different species for the present form.

Pristina minuta (Stephenson, 1914).

[?] *Naidium osborni* Walton, 1906, pp. 703—704, Fig. 12.
[?] *Naidium osborni* Walton. Galloway, 1911, p. 302. Smith, 1918, p. 640.
Naidium minutum Stephenson, 1914, pp. 327—330, Figs. 3—5.
Naidium minutum Stephenson. Stephenson, 1923, pp. 68—69, Fig. 22. Marcus, 1943, pp. 129—130, Pl. XXV, figs. 103—104.

No proboscis. Hair setae 1 per bundle, non-serrated; needles 1 per bundle, with distal nodulus, and short teeth, equally long, separated at a wide angle; ventral setae 3—5 per bundle anteriorly, 2—3 posteriorly, increasing in length in anterior segments, those of II being finer than the rest, with distal tooth longer than proximal, and nodulus proximal; behind II nodulus distal, and prongs growing equally long posteriorly. Stomach in VII or VIII, sudden, with canals; septal glands in IV—V, occasionally also in III and VI. $n = 12$. $l = 2$ mm.

India, Brazil, N. America?

The hair setae are stated to be 80—120 μ long, 1 μ thick, the needles 30—35 μ long, more than 1 μ thick, the ventral setae 30—40 μ long, 1.25 μ thick. It is not expressly stated that the stomach contains intra-cellular canals, but Marcus' figure (op. cit., Pl. XXV, fig. 103) shows the same appearance as in *Pr. longiseta* — with large, oblong cells. Marcus states that the stomach in his specimens lies in VII, in contrast to the Indian specimens with the stomach in VIII; nevertheless he figures it in VIII.

It seems very probable that this species is identical with *Naidium osborni* Walton. This has 1 hair, 145 μ long, and 1 needle, 50 μ long, with "remote" teeth, and ventral setae 4 per bundle, with subequal teeth and the stomach sudden, in VIII. $l = 1.6$ mm. $s = 15$—16. MARCUS rejects the identity, on account of the hair setae being longer than the diameter in *N. osborni*, shorter in *Pr. minuta*; in fact, they may be longer in the latter, too, he himself giving their length as up to 120 μ, the diameter as 100 μ. Also, the needles are longer in *N. osborni*, but the difference is not at all so great as M. states, the needles being 50 μ, not 120 μ. It is perhaps better to wait until the N. American species has been reinvestigated, before definitely uniting the two species. If they are really identical, the species will have the name *Pristina osborni* (Walton).

Pristina notopora Černosvitov, 1937.

Pristina notopora ČERNOSVITOV, 1937 b, pp. 140—141, Figs. 13—16.

No proboscis. Hair setae 1—2 per bundle, serrated, needles 1—2 per bundle, bifid, with short, fine, equal teeth, diverging at an acute angle; ventral setae 4—7 per bundle anteriorly, 2—4 posteriorly, increasing in length backwards in anterior segments, with distal prong longer than proximal in II and III, equally long in the middle segments, and shorter posteriorly. Stomachal dilatation sudden, in VIII. Nephridia opening to the exterior in front of the dorsal setal bundles. $n = 26$. $s = 28$. $l = 1.5$—2.5 mm.

S. America (Argentine).

The hairs are stated to be 80—200 μ long, the needles 36—40 μ, the ventral setae 36—44 μ. The systematic significance of the dorsal situation of the nephridiopores is difficult to judge. It is probably not great, as the species seems to closely resemble other species of *Pristina*, especially *Pr. minuta*, except that it has serrated ("pennées") hairs, needle teeth at an acute angle, and larger values of n and s.

Pristina sima (Marcus, 1944).

Naidium simum MARCUS, 1944, pp. 68—69, Pl. XIII, figs. 58—59.

No proboscis. Hair setae 1 per bundle, non-serrated; needles 1 per bundle, bifid, with fairly short teeth, and usually 2—3 intermediate teeth; nodulus weak, distal; ventral setae 3—5 per bundle, increasing in length in anterior segments, in II—VII distal prong longer, in the rest shorter than proximal, nodulus in II proximal, in the neighbouring segments median, posteriorly distal. Stomach in VIII, with canals. $n = 14$. $l = 2$ mm.

S. America (Brazil).

The hair setae are stated to be 90—140 μ long, the needles 30—35 μ, the ventral setae 25—35 μ. The needle teeth judging from the figure (op. cit., Pl. XIII, fig. 59 D) are less than 2.5 μ long. About the stomach the same applies as in *Pr. minuta*. MARCUS considers that the species is closely related to *Pr. notopora*, and apart from the intermediate needle teeth, and the situation of the nephridiopores in the latter, they really resemble each other closely, and so does *Pr. minuta*.

Pristina jenkinae (Stephenson, 1931).

[?] *Naidium luteum* Schmidt. MICHAELSEN, 1905 b, p. 306.
Naidium jenkinae STEPHENSON, 1931 b, pp. 39—41, Fig. 1.
Naidium jenkinae Stephenson. STEPHENSON, 1932, p. 237.
[?] *Pristina rosea* (Piguet). MICHAELSEN & BOLDT, 1932, pp. 596—597. KONDÔ, 1936, pp. 386—387, Pl. XXIV, fig. 16.
Naidium roseum Piguet. MARCUS, 1943, pp. 130—131, Pl. XXV, fig. 105, Pl. XXVI, fig. 106.

No proboscis. Dorsal bundles containing usually 1 non-serrated hair, and 1 fairly stout needle, with distal nodulus, and long teeth, the distal tooth being shorter and thinner than the proximal; ventral setae 4—6 per bundle anteriorly, 2—3 posteriorly, in anterior segments nodulus median, farther back distal, all with prongs about equally long. Stomach in VII. $n = 19$. l (preserved) = 2.5—3 mm.

E. Africa, S. America, Sumatra? Japan?

The hair setae are stated by STEPHENSON to be 165—234 μ long, the needles 62—65 μ long, 2 μ thick, with proximal tooth 5—9 μ long, the ventral setae 47—55 μ long, 2 μ thick. S. could not distinguish any intra-cellular canals in the stomach, but he mentions that this could not be determined with any certainty, as he only had two specimens.

Naidium roseum Piguet of MARCUS (1943) seems really to belong to the present species. The most striking feature is the long, strong teeth of the needles, the proximal being much longer, about 9 μ judging from the figure (op. cit., Pl. XXVI, fig. 106 C), and stouter than the distal. In *Pristina rosea* the teeth are much shorter, about $\frac{1.8\,\mu}{3.3\,\mu}$, and both are fine (cf. p. 210), while in the present species they are quite similar to those of MARCUS' figure. Also the measurements of the setae conform very well, the hairs of MARCUS' specimens being up to 300 μ long, the needles up to 70 μ, and the ventral setae 50—55 μ. The distal prong of the ventral setae is stated to be longer than the proximal in the anterior segments, posteriorly becoming shorter, whereas STEPHENSON stated them to be equally long in all segments. This is much less probable, as the relations between the teeth are seldom the same in all segments S. probably did not notice an actual small difference in the scanty, preserved material. MARCUS observed intra-cellular canals in his specimens. — MARCUS identifies his specimens with *Pr. rosea*, instead of *Pr. jenkinae* (which he considers as only a form of the former), on account of the place of the budding-zone (in XV—XVII), and the form of the prostomium — elongated instead of forming "an equilateral triangle", as in the latter. These differences, however, cannot be significant. The size of *n* in *Pr. jenkinae* counted in 2 specimens cannot represent the limits in the species, and SCHUSTER has found it to be 18 in *Pr. rosea.* The shape of the prostomium in *Pr. jenkinae* was determined from preserved material, and cannot be directly compared with the shape in living animals.

Very probably *Pristina rosea* (Piguet) of MICHAELSEN & BOLDT (1932), and of KONDÔ (1936) also belong here. The former authors argue that *Pristina synclites* Stephenson ought to be united with *Pr. rosea*; *Pr. synclites*, however, has long, stout needle teeth, reminiscent of those of *Pr. jenkinae* but not of those of *Pr. rosea*, so that it would seem fairly natural to unite *Pr. jenkinae* with *Pr. synclites* (except for the proboscis), while nobody who has seen the needles of *Pr. rosea* would think of uniting this species with *Pr. synclites.* Also, the figure of a needle in *Pr. rosea*, reported by KONDÔ (1936, Pl. XXIV, fig. 16 a), speaks strongly in favour of *Pr. jenkinae*, as does the colour of the worm, described as chalk-white, while *Pr. rosea* is actually rose-coloured (cf. p. 210).

About *Naidium luteum* O. Schmidt of MICHAELSEN (1905 b) see p. 212.

Pristina synclites Stephenson, 1925.

Pristina synclites STEPHENSON, 1925 c, pp. 45—46, Pl. III, fig. 1.

Prostomium forming a short proboscis. Hair setae 1—2 per bundle, non-serrated; needles 1—2 per bundle, stout, with a weak nodulus, and long teeth, the proximal slightly the longer; ventral setae 4 per bundle in anterior segments, decreasing in number backwards, with prongs equally long; in II—VII nodulus median or slightly proximal, in the following segments distal. Stomach in VIII; septal glands in IV—V. Free commissural loops at least in VI—VII. $n = 18—22$. $s = 35—61$. l (preserved) = 5—7 mm.

S. Asia (India).

The hairs are stated to be up to 350 μ long, the needles 60—82 μ, and the ventral setae behind the first segments 63—71 μ. The species apparently resembles *Pr. peruviana* fairly closely, only the setae are shorter, the needle teeth unequal, and the hairs non-serrated.

STEPHENSON reports numerous vascular loops in the hind half of the second zooid, attached to the body-wall. They did not occur in anterior zooids. The case needs investigation.

Pristina breviseta Bourne, 1891.

Pristina breviseta BOURNE, 1891, pp. 353—355, Pl. XXVII, figs. 11—15.

Pristina breviseta Bourne. BEDDARD, 1895, p. 292. MICHAELSEN & BOLDT, 1932, p. 595.

Naidium breviseta (Bourne). MICHAELSEN, 1900, p. 23. PIGUET, 1906, p. 216. STE-

PHENSON, 1923, pp. 67—68; 1926 a, pp. 290—299, Figs. 1—4. AIYER, 1925, pp. 32—33, Figs. 1—2; 1930, pp. 23—24. CHEN, 1940, pp. 42—43. MARCUS, 1943, pp. 128—129, Pl. XXV, figs. 101—102.

Prostomium usually forming a short proboscis. Hair setae 1 per bundle, non-serrated; needles 1 per bundle, stout, curved distally, with a weak nodulus, and long, equal teeth; ventral setae 3—5 per bundle, increasing in length backwards in anterior segments, those of II straighter, with nodulus median, and distal prong longer than proximal, in posterior segments setae more curved, with nodulus distal, and proximal prong longer than distal. Stomachal dilatation in VII, with intracellular canals. Transverse commissural loops in II—VII, stronger in V—VII. Clitellum in $^1/_2$ VII—IX dorsally, absent or weak mid-ventrally; 1 single genital seta to the right of the spermathecae in VII, another hindmost in VII, or in VIII, on the left side, both setae being strongly curved proximally, with two enormous converging prongs, united by a membrane, and both enclosed within genital glands; spermathecal ampullae small, thick-walled, ducts narrow, both opening into one pit, in common or apart; male funnels cup-shaped, vasa deferentia narrow, surrounded by gland cells; atrial ampullae fairly high, with narrow lumen, ducts narrow, thin-walled, both opening in common into a median pit. $n = 18—26$. $s = 35—120$. $l = 10—20$ mm.

S. and E. Asia, S. and N. America.

This species is characterized by its flesh-red colour, which is dotted with white from the coelomocytes (AIYER, 1925). The seta measurements are somewhat larger in the Indian specimens (AIYER, 1925) than in the S. American (MARCUS, 1943). In the former the hairs are stated to be 290 μ, the needles up to 95 μ, and the ventral setae 76—95 μ, in the latter the corresponding measurements are 140—320 μ, 45—70 μ, and 62—71 μ, respectively.

The setal characters resemble very much those of *Pr. peruviana*, *synclites*, and *americana*, but the sexual organs are considerably different from those of the latter.

Pristina americana Černosvitov, 1937.

Pristina americana f. typica ČERNOSVITOV, 1937 b, pp. 136—138, Figs. 1—5, 10.

Pristina americana var. *loretana* ČERNOSVITOV, 1937 b, pp. 139—140, Figs. 6—9, 11—12.

Pristina americana Černosvitov. MARCUS, 1943, pp. 106—107, 123, Pl. XIX, fig. 82, Pl. XX, fig. 80, Pl. XXI, fig. 83, Pl. XXIV, fig. 98.

Prostomium forming a proboscis. Hair setae 1—2 per bundle, serrated; needles 1—2 per bundle, stout, slightly curved distally, with distal nodulus, and long teeth, the distal shorter than the proximal, or occasionally absent; ventral setae in anterior segments 3—6 per bundle, diminishing posteriorly to 1—2, increasing in length backwards in anterior segments; in II distal tooth longer than proximal, and nodulus proximal; in III teeth equally long, and nodulus median; the rest with distal tooth shorter than proximal, and distal nodulus. Stomach beginning in VII, with intra-cellular canals. Commissural vascular loops in II—V branching and anastomosing, in VI—VII simple, pulsating. Clitellum in $^{1}/_{2}$ VII—$^{1}/_{2}$ IX dorsally and ventrally; genital setae in VI 3—5 per bundle, curved, elongated, with distal prong long and straight, proximal prong sometimes bifid; penetrating projections from the body-wall; in VIII 1 per bundle, very long and thick, straight, slightly curved and thickened distally, with a longitudinal groove; situated in a deep pocket, branching proximally, the anterior branch surrounded by a glandular mass; spermathecal ampulla long, duct more or less narrow; male funnels large, cup-shaped, vasa deferentia narrow, in their median part surrounded by gland cells; atria very long, tubular, sometimes curved, duct short, surrounded by gland cells. $n = 22$—45. $l = 10$—30 mm.

S. America.

Černosvitov described two forms of this species, f. *typica*, and var. *loretana*, both from the same place. The f. *typica* are stated to be much larger, up to 30 mm, against 12—15 mm, having also longer setae. Thus, the hair setae of the f. *typica* are stated to be up to 450 μ long, and the needles $^{1}/_{4}$ of this (up to 112 μ), with the distal tooth 9—10 μ, and the proximal tooth 10—13 μ, whereas in the variety the corresponding measurements are 300—320 μ, 3—3 $^{1}/_{2}$ times as long as the needles, which have teeth $\frac{6\,\mu}{7\,\mu}$—$\frac{5\,\mu}{6\,\mu}$. The ventral setae are stated to increase in length from 70—80 μ in II to 110—112 μ in VII, decreasing abruptly to 90—100 μ in VIII, in the main form; in the variety the measurements are 70 to 90 μ in II—VI, 75 μ in VII, 60—65 μ in the rest. Marcus has, however, specimens referred to the typical form with ventral setae increasing only to 100 μ, hairs as long as 550 μ, and needles 65—125 μ, thus with ventral setae shorter, but with the dorsal setae attaining a greater length than stated by Č. It seems that the measurements may vary considerably, and probably the variety represents only a modification, as it cannot possibly be a geographical race. The spermathecal duct was stated to be less well-defined, and the atrial ampulla longer in the variety, but as Č. had only one fully mature specimen of both forms, these differences seem hardly significant. The dilatation of the nephridial ducts, recorded by Černosvitov for the typical form, is not mentioned by Marcus.

The penial setae of this species resemble those of *Pr. plumaseta*, in their situation in a pocket, surrounded by gland cells; the same situation applies to the genital setae of VI, which penetrate projections of the body-wall.

Pristina peruviana Černosvitov, 1939.

Pristina peruviana Černosvitov, 1939, pp. 83—84, Figs. 1—7.

Prostomium forming a short proboscis. Hair setae 2—4 per bundle, stiff, closely serrated; needles 1—3 per bundle, stout, with a weak nodulus, and two long, equal, parallel teeth; ventral setae 4—6 per bundle, increasing in length in anterior segments, all approximately similar, with slightly longer distal prong. Stomachal dilatation sudden, in VIII. Septal glands in IV—V. Anterior commissural vessels branching. $n = 17$—20. $l = 4$—4.5 mm (preserved).

S. America (Peru).

The hair setae are stated to be up to 425 μ long, the needles 70—92 μ with teeth 10—12 μ long, and the ventral setae 80 μ in II, increasing to 90—95 μ backwards. The ventral setae in the anterior segments are stated to have equally long teeth, but the figure (op. cit., Fig. 5) plainly shows a longer distal tooth. Nothing is stated about the appearance of the stomachal cells.

The characters known indicate a relationship to *Pr. americana.*

Pristina plumaseta Turner, 1935.

[?] *Pristina breviseta* Bourne. HAYDEN, 1912, p. 531.
[?] *Pristina variabilis* HAYDEN, 1914, p. 136.
Pristina plumaseta TURNER, 1935, pp. 253—258, Figs. 1—2.

Prostomium forming a short proboscis. Hair setae 1—2 per bundle, serrated, with serrations in two rows; needles 1—2 per bundle, bifid, with distal half bayonet-curved, and with distal tooth slightly longer and thicker than proximal, nodulus about median; ventral setae 4—8 per bundle anteriorly, 2—4 posteriorly, with nodulus slightly distal, and prongs subequal. Stomachal dilatation beginning in VII (?), slow. Clitellum in VII—$^1/_2$ X dorsally, in IX—$^1/_2$ X ventrally; genital setae in VI and VIII, more than twice as long as the ordinary setae, slightly curved, simple-pointed, terminating distally in a knob, with a longitudinal groove along one side, in VI 4 per bundle, situated on lobular projections, in VIII situated behind the atria, in pockets, surrounded by gland cells; spermathecal ampulla large, duct fairly long, thin-walled; the ducts of both sides opening into a common, transverse groove; vasa deferentia very long, winding, covered with prostate cells; atria short, wide, duct inconspicuous. $n = 22$—24. $s =$ about 52. $l = 8$—12 mm.

N. America.

The hairs are stated to be 170—354 μ long, the needles 35—65 μ, the ventral setae 38—61 μ. It is not stated whether the needles are fine or stout, their teeth long or short, nor whether the stomach contains any intra-cellular canals.

Possibly the species *Pr. variabilis* Hayden (1914), at first described as a form of *Pristina breviseta* (HAYDEN, 1912), may belong here. It is stated to have a proboscis, bifid needles with unequal teeth, and 5—8 ventral setae per bundle. Its size is considerably smaller than that indicated by TURNER for *Pr. plumaseta*, being only 1.5 mm ($n = 15$, $s = 30$), smaller than any of the species which can be considered. *Pr. plumaseta*, however, seems to be the only species so far found in N. America which can come into the matter, and the size indeed often varies very much within the species of the genus. It may of course also constitute a species of its own, but it is far too poorly described to make this possible to judge at the present. If it is a new species, however, it will have to be renamed, as the name *Pr. variabilis* is preoccupied (FRIEND, 1912; cf. p. 119).

Pristina foreli (Piguet, 1906).

Pl. XXI, fig. 4.

[?] *Pristina inaequalis* EHRENBERG, 1828, p. 112, foot-note.
[?] *Pristinais inaequalis* (Ehrenberg). GERVAIS, 1838, p. 17.
[?] *Pristina inaequalis* Ehrenberg. GRUBE, 1851, p. 105. VEJDOVSKY, 1884, p. 24. VAILLANT, 1890, p. 360.
Naidium foreli PIGUET, 1906, pp. 222—223, Pl. IX, figs. 21, 25, 27—28.
Naidium foreli Piguet. PIGUET, 1909, p. 175.
Pristina foreli (Piguet). MICHAELSEN, 1909 a, p. 27, Figs. 45—46. PIGUET & BRETSCHER, 1913, pp. 53—54. SCHUSTER, 1915, pp. 50, 76. SVETLOV, 1924, p. 197. UDE, 1929, p. 32, Figs. 32—33. ČERNOSVITOV, 1930, p. 9.
Pristina palustris SCHUSTER, 1915, pp. 51—53, Figs. 33—35.
Pristina palustris Schuster. HEMPELMANN, 1923, p. 434. UDE, 1929, p. 32. SZARSKI, 1936 b, pp. 392—393, 397—398, 401, 404—406, Pl. XVIII, figs. 6—8, 11, 13—15, 17—18.
[?] *Pristina capiliseta* KONDÔ, 1936, p. 388, Pl. XXIV, fig. 19.
[?] *Pristina nasalis* KONDÔ, 1936, pp. 388—389, Pl. XXIV, fig. 20.

Prostomium forming a proboscis. Hair setae very finely serrated, 1—4 per bundle; needles finely bifid, slightly curved distally, without a nodulus, 1—4 per bundle; ventral setae 2—8 per bundle, in II slightly longer than the rest, with nodulus proximal, in the rest nodulus distal; in II—VII distal tooth longer than proximal, behind VII teeth equally long, the distal growing shorter backwards. Transverse commissural loops in II—VII, occasionally those of II and III anastomosing. $n = 13—19$. $s = 20—26$. $l = 3—6.5$ mm.

Europe, Turkestan, Japan?

Sweden: Waters in Småland (ALMSTEDT, 1946); Ekoln, Skedviken, Åkerö tjärn, Lilla Gladaviken, Kyrksjön, Älgträsket.

Pristina inaequalis Ehrenberg may belong here, or to *Pr. aequiseta*. Besides the proboscis its characteristics are given as follows: "setis quaternis inaequalibus, una longissima reliquis brevissimis, pari secundo non diverso, uncinis subquinis subulatis."

Pristina palustris Schuster will no doubt belong here. The differences are stated to be: the different number and shape of the setae, the different shape of the brain, the place of the stomach, and the configuration of the vascular system. As to the number of setae, they are stated to be 2—5 ventrally, and 1—2 of each sort dorsally in *Pr. foreli*, against 5—7, and usually 3, respectively in *Pr. palustris*; I found up to 8 ventrally in the former, and usually 2 dorsally — PIGUET found usually 1, so these characters apparently vary. The shape of the setae seems to be exactly the same. About the shape of the brain, nothing is stated by anybody in *Pr. foreli*, and I found no difference from SCHUSTER's description of the brain in

Pr. palustris. The place of the stomach varies slightly in most species (cf. p. 28). I could not discover, in *Pr. foreli,* the anastomosis which is stated to be present in *Pr. palustris,* but such a character is bound to vary.

Possibly *Pr. capiliseta,* and *Pr. nasalis* Kondô may belong here. Both are described with a proboscis, 1—2 hairs, serrated in the former, non-serrated in the latter, finely bifid needles, ventral setae 3—5 per bundle. As to the serration, it is very difficult to detect (Piguet did not see it), and Kondô may well have failed to find it in some specimens.

Pl. XXI, fig. 4 gives a complete view of the animal.

Below is a table of measurements from one specimen.

	v. s. II	v. s. III	v. s. IV	v. s. VII	v. s. VIII	v. s. post.	n. s.	h. s.
length	59–60	47–52	48–51	54–57	53–57	48–53	38–51	135–430
thickn.	1.4	1.4	1.5	1.5	1.5	1.6	0.8–1.1	1.7
teeth	$\frac{3.5\text{–}3.7}{2.3\text{–}3}$	$\frac{3.5}{2.5\text{–}2.8}$	$\frac{3\text{–}3.5}{2.5}$	$\frac{2.4\text{–}3}{2.4\text{–}2.9}$	$\frac{2.8\text{–}3}{2.8\text{–}3}$	$\frac{2.1\text{–}2.3}{3}$	$\frac{1.5}{1.5}$	

The seta measurements found in the literature are: ventrally in II 58 μ, in III 46—54 μ, in VII 34—54 μ, in VIII 32—53 μ, in the posterior segments 34—50 μ, needles 23—50 μ, hairs 118—362 μ. My extreme measurements are: ventrally in II 53—65 μ, in III 44—52 μ, in VII 48—57 μ, in VIII 53—57 μ, in the rest 45—54 μ, needles 38—63 μ, hairs 150—480 μ.

Pristina aequiseta Bourne, 1891.

Fig. 24; Pl. XXI, fig. 5.

Pristina equiseta Bourne, 1891, pp. 352—353.
Pristina equiseta Bourne. Beddard, 1895, pp. 291—292. Malevich, 1927, p. 9.
Pristina affinis Garbini, 1898, pp. 562—564, Fig. 1.
Pristina aequiseta Bourne. Michaelsen, 1900, p. 34 [*partim*]; 1905 b, pp. 309—310 [*partim*]; 1926 c, pp. 5—6; 1933, p. 341. Piguet, 1909, pp. 211—217. Stephenson, 1909 a, pp. 269—272, Pl. XVIII, figs. 34—39, Pl. XIX, fig. 40; 1916, p. 304; 1922 a, pp. 253—254; 1923, pp. 71—73; 1931 b, p. 42; 1932, p. 237. Piguet & Bretscher, 1913, pp. 52—53. Schuster, 1915, pp. 50, 77. Hayden, 1922, p. 168. Hempelmann, 1923, pp. 380—444. Svetlov, 1924, p. 197. Ude, 1929, p. 30, Figs. 27—28. Černosvitov, 1930, p. 9. Pasquali, 1938, p. 20. Chen, 1940, p. 48. Marcus, 1943, pp. 104—106, Pl. XIX, fig. 81.
Naidium tentaculatum Piguet, 1906, pp. 219—222, Pl. IX, figs. 18—20, 26.
Pristina tentaculata (Piguet). Michaelsen, 1909 a, pp. 26—27, Fig. 44; 1909 b, pp. 134—135.
Pristina aequiseta Bourne, var.? Michaelsen, 1913, pp. 209—211.

Prostomium forming a proboscis. Dorsal setae 1—2 finely serrated hairs and 1—2 finely bifid needles, slightly curved distally, but without a nodulus; ventral setae in most segments 5—8 per bundle, those of II longer and thinner than the rest, with nodulus slightly proximal, and with distal tooth twice as long as proximal; in III —VII shorter and slightly thicker, with nodulus distal, and with distal tooth slightly longer than proximal, or, usually, in IV or V, or both, enlarged setae, much thicker than the rest, with distal prong more than twice as long as proximal, or the latter missing; behind VII setae thicker, more curved, with equally long teeth. Septal glands in III—V. Commissural vascular loops in II—VII. $n = 12$—23. $s = 18$—23. $l = 2$—8 mm.

Cosmopolitan. Also in oligohaline water (the West Indies).

Sweden: Uppsala (hot-house), Åkerö tjärn, Gersjön.

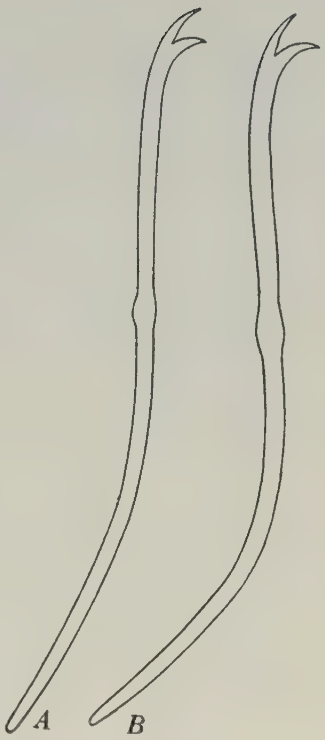

Fig. 24. *Pristina aequiseta.* Ventral setae, *A* from II, *B* from VIII. 2000 ×.

It seems probable that *Pristina affinis* Garbini, from Italy, belongs here. It was described and figured with 1—2 fairly short hair setae per bundle, the ventral setae all alike, a very long proboscis, a stomach with special cells, and septal glands in III—IV. Piguet (1909, pp. 212—213) considered that it probably belonged here, and so does Pasquali (1938), who found *Pr. aequiseta* herself in Italy. Michaelsen placed it (1909 b) in *Pr. proboscidea,* and in *Pr. aequiseta* (1913). The description allows of no definite judgement, but the geographical distribution of the two species in question decidedly suggests *Pr. aequiseta.*

Pl. XXI, fig. 5 shows a complete view.

Seta measurements from one specimen are given below:

	v. s. II	v. s. III	v. s. IV	v. s. V	v. s. VII	v. s. VIII	v. s. post.	n. s.	h. s.
length.........	54–56	44–48	49–53	45–47	48–49	48	45–50	30–43	120–205
thickn.........	1.3	1.5	3	1.4	1.4	1.6	1.6	1.4	1.8
teeth..........	$\frac{4}{2}$	$\frac{3\text{–}4}{2.5}$	$\frac{7}{3}$	$\frac{3}{2.5}$	$\frac{3}{2.5}$	$\frac{3}{3}$	$\frac{2.9\text{–}3}{3}$	$\frac{1.5}{1.5}$	

It has not been stressed in the literature that the appearance of the ventral setae changes abruptly after VII, getting thicker, and considerably more curved, with equally long teeth (Fig. 24; cf. Marcus, 1943, Pl. XIX, fig. 81 A, C). Often, apparently, only normal ventral setae may be found (Bourne, 1891; Michaelsen, 1913; Svetlov, 1924; Malevich, 1927; Chen, 1940), though in my specimens enlarged setae were always present.

The seta measurements found in the literature are: ventrally in II 62 μ, in III 46 μ, in VII 56 μ, in VIII 56 μ, in the posterior segments 50 μ, needles 33—54 μ, hairs 121—262 μ. I found ventrally in II 54—66 μ, in III 42—48 μ, in IV 49—70 μ, in V 45—57 μ, in posterior segments 45—57 μ, needles 30—69 μ, hairs 120—270 μ.

Pristina evelinae Marcus, 1943.

Fig. 25.

Pristina evelinae Marcus, 1943, pp. 112—116, Pl. XX, fig. 80, Pl. XXII, figs. 89—91, Pl. XXIV, fig. 99.

Prostomium forming a proboscis. Dorsal setal bundles containing 1 hair, and 1 finely bifid needle, slightly curved distally; ventral setae 4—6 per bundle, with nodulus distal, in II longer than the rest, with distal prong longer than proximal; towards the posterior both prongs growing equally long; in V 1 giant seta per bundle, very thick, twice as long as ordinary setae, with simple distal end. Septal glands in III—V. Transverse commissural vessels in II—VIII, enlarged in VI—VIII. Clitellum dorsally in VIII—IX, ventrally in IX; in VI, and sometimes in VII, strongly enlarged genital setae with bifid distal end; behind the setae of VI a pair of genital glands, and, medially in VIII, behind the male pores, an unpaired glandular mass; spermathecal ampulla fairly large, pear-shaped, duct well-defined, very narrow; male funnels large, tubular, vasa deferentia very thick, glandular; atrial ampulla infinitely small, duct very long, curved, with narrow lumen. $n = 13—14$. $s = 13—20$. $l = 2—5$ mm.

S. America (Brazil).

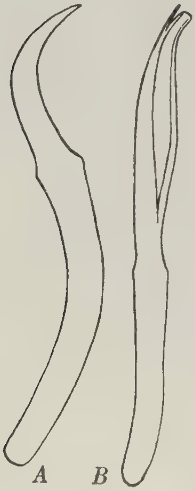

Fig. 25. *Pristina evelinae*. *A* giant seta from V, *B* genital seta (from Marcus, 1943). About 800 ×.

The hair setae are stated to be up to 150 μ long, the needles 40 μ, the ventral setae in II 55 μ, the ordinary ventral setae 34—40 μ, the giant setae of V 80 μ long, 6 μ thick, and the genital setae 80 μ long, 4—6 μ thick. The giant setae and genital setae are shown in Fig. 25.

Pr. evelinae is probably most closely related to *Pr. aequiseta*, having the enlarged ventral setae in V, the finely bifid, slightly curved needles without a nodulus and the few, short hair setae. Marcus speaks of a nodulus in the needles of *Pr. evelinae*, and his fig. 90 D shows a slight one, but he also indicates one in *Pr. aequiseta* (op. cit., fig. 81 D), where there is none (at least in the European specimens), so presumably it markes only the beginning of the curve.

Pristina longiseta Ehrenberg, 1828.

Prostomium forming a proboscis. Hair setae serrated, in III extremely elongated, non-serrated; needle setae fine, straight, without nodulus, simple-pointed or very finely bifid; ventral setae of II and III differing in shape from the rest, with nodulus median, and distal prong 2—3 times as long as proximal; in the rest nodulus distal, and distal prong less than twice as long as proximal. Stomach in VIII, septal glands in III—V or IV—VI. Simple transverse commissural vessels usually in II—VII, stronger in VI—VII, occasional anastomoses in anterior segments. Clitellum in $^1/_2$VII—$^1/_2$IX, weaker ventrally; genital setae in VI, in connection with a pair of genital glands; male funnels cup-shaped, vasa deferentia glandular, atria elongate, of varying size.

When EHRENBERG described the present species, he naturally failed to see the serration of the hair setae, and so did not mention it in his diagnosis; neither did other early authors, e. g. VEJDOVSKY (1884), observe this feature. So SMITH (1896), on observing serrations in the American form (and also assuming some differences as regards the occurrence of the nephridia), regarded this form as a new species, named *Pr. leidyi*, as SMITH assumed the specimens recorded by LEIDY (1850) to belong to this species. Later MICHAELSEN (1905 a) found serrations in European specimens (from Hamburg), and in specimens from Paraguay, too, and accordingly recorded them as belonging to *Pr. leidyi*, at the same time expressing his belief that the earlier described European specimens also had serrated hairs, and belonged to the same species. Later in the same year (1905 b) he reports specimens with very fine serrations from Zanzibar, finer than in the Hamburg specimens, and much finer and closer yet than in those from Paraguay, and those described by SMITH. The two latter forms he ascribes to "var. *leidyi* (Fr. Smith)", the two former to the "typical form", on account of the difference in this character; the distance between the teeth on the hairs in the variety he reports (1905 a), like SMITH, as 6 μ. This arrangement, with a "f. *typica*" and a "var. *leidyi*", has afterwards been retained until CHEN (1940) again separated the two forms as species, on account of differences he found between the N. American form and the Chinese (see below).

Actually, several characters, concerning the setae as well as the sexual organs, seem to separate the N. American form from the rest, which is not, however, homogeneous at all. If the *leidyi* form is compared with the European, as described chiefly by PIGUET (1906), and found by myself, the following differences transpire:

In my specimens the serrations of the hair setae are very fine, 2—3 μ apart. — The ventral setae of II are slightly longer and thinner than the rest, those of III slightly longer and thicker than those of the following segments. The distal tooth in II and III is about twice as long as the proximal, and it is longer than the latter in all segments.

In the N. American form, according to CHEN (1940), the saw-teeth of the hair setae are 8—16 μ apart, and the ventral setae of both II and III are thicker than those of IV (2.4 μ), but similar in shape, with the distal tooth about three times as long as the proximal.

In the European form, according to PIGUET (1906), the genital glands of VI are situated behind the genital setae, which are slightly curved and stated to be probably simple-pointed (cf. below), whereas in the N. American form, according to SMITH (1896), the glands envelop the genital setae, and these are double-pronged, resembling ordinary setae, only being straighter and one half again as long. The spermathecae seem to resemble one another in the two forms, with a very short duct, but the ampulla according to PIGUET is long, according to SMITH very short, but this may be due to a different degree of maturity. The atria in the European form are high, much wider than the vasa deferentia, and with thicker walls, though both are glandular. The ejaculatory duct is short but quite conspicuous, but much narrower, and with thinner walls than the atrial ampulla, and it opens on a small projection of the body-wall. In SMITH's description no atria can be discerned, the lumen of the efferent apparatus being wide along its whole course, and the walls about equally thick. It makes a considerable curve upwards behind the male funnel, the anterior half being glandular, and the posterior muscular in appearance — the latter probably represents either atrium and duct or only the ejaculatory duct.

Setal measurements from one Swedish specimen are given in the following table:

	v. s. II	v. s. III	v. s. IV	v. s. VII	v. s. VIII	v. s XI	n. s.	h. s. III
length	62–67	59–63	51–56	57–62	53–57	54–56	47–48	740–800
thickn.	1.4–1.5	2	1.6–1.8	1.6–1.8	1.6–1.8	1.6–1.8	1.3	2.4
teeth	$\frac{3.5-4}{2-2.5}$	$\frac{3.5-4}{2}$	$\frac{3.5}{2.5}$	$\frac{3.5}{2.5}$	$\frac{3.5}{2.5}$	$\frac{3.5}{2.5}$		

The extreme setal lengths that I have found are: ventral setae in II 57—75 μ, in III 59—70 μ, in the rest 50—58 μ, needles 47—60 μ, elongated hairs 600—800 μ, the rest 120—285 μ.

Very similar to, or identical with the European form, appears the Indian form, as recorded by MICHAELSEN (1909 b), STEPHENSON, and AIYER. It is not very well described, but the serration of the hairs is close, though not always exceedingly fine (AIYER, 1930), and the ventral setae of II are longer, and those of III longer and thicker than those following (STEPHENSON, 1923). STEPHENSON (1909 a) described the genital setae as curved and simple-pointed. AIYER (1930, p. 24, Fig. 4) corrected this description; they have distally two enormous prongs, almost parallel, united by a membrane, and converging at the tips, easily mistaken for a simple tip. Very possibly the setae in the specimens described by PIGUET (1906) may have had the same shape.

The form recorded by CHEN from China differs from both the N. American and the European-Indian form. From the former it differs in having very finely serrated hairs, and from both in having the ventral setae of II thicker than the rest, except for those of III, which are very stout, 3.4 μ, with the distal tooth 3 times the length of the proximal, and only half as many per bundle (3—5) as in the neighbouring segments (in the two previous forms they are 4—6 per bundle, not fewer than in the adjacent segments). Very similar to this form is the one recorded by STEPHENSON (1931 b) from Kenya, which has enlarged setae in III, 3.5 μ thick, resembling those of *Pr. aequiseta* (cf. op. cit., Fig. 2), and only 2 per bundle.

Another form is *Pr. longiseta* var. *bidentata* Černosvitov from Argentine, including the apparently identical form of *Pr. longiseta* recorded by MARCUS (1943) from Brazil. Here, the serration of the hairs is close, about 3.75 μ, and the needles are extremely finely bifid at the tip, the teeth being 0.75 μ long. The ventral setae of II are much longer and thicker than those following, being 84—96 μ long, 3 μ thick, against 66—72 μ long, 2 μ thick in III, 57—65 μ long, and 1.5 μ thick behind IV. There are 3—5 setae per bundle in II and III, and as many as 13 in the hinder segments. The distal prong, which is twice as long as the proximal in II, becomes equal in length to it in the posterior segments in contrast to the conditions in the previous forms. The sexual organs (MARCUS, 1943, pp. 123—124, Pl. XX, fig. 80, Pl. XXV, fig. 100) resemble most closely those of the *leidyi* form. It has long, straight, bifid genital setae which M. supposes to be precursors to the long-bifid type, which would appear at a more mature stage. The atria are hardly discernible, apparently with thinner walls than in the *leidyi* form, and without any conspicuous ejaculatory duct. The genital glands in VI, however, are not connected with the genital setae, the spermathecal duct is fairly long, and an additional pair of glandular masses are present behind the atria.

There are also records of *Pr. longiseta* "f. *typica*," and *leidyi* from S. America, but it seems quite probable that they really belong to the "var. *bidentata*", as the bifid condition of the needles must be next to impossible to see in preserved specimens. *Pristina leidyi* was recorded by MICHAELSEN (1905 a) from Paraguay, and given this name solely on account of the distance between the saw-teeth of the hair setae (6 μ in the middle of the setae). This may very well lie within the range of variation of the *bidentata* form. The same applies to the f. *typica* recorded by M. (1913), from Columbia and (1921) from Argentine, and by CORDERO (1931) from Uruguay. PIGUET (1928), who describes specimens from Peru, gives no detailed account of the setae, but gives the measurements of the ventral setae as 72—94 μ, which agrees well with the *bidentata* form but is considerably more than in the typical form (75 μ at most). The serration of the hairs is stated to be fine, but less so than in the European specimens.

From the above review it appears therefore that the distribution of the different forms of the *longiseta* complex indicates that they are geographical races, or perhaps even species, forming together a "Rassenkreis," or an "Artenkreis." We get one, *Pr. longiseta longiseta*, distributed in Europe, and probably Western Asia to India, one race in China, so similar to the one in Kenya that I have provisionally united them, though they are more probably different races. (The records of *Pr. longiseta* from Zanzibar, by MICHAELSEN (1905 b) and from Lake Nyasa by CUNNINGTON (1920) may also refer to the Kenya form, but it is impossible to judge from the records.) The race *longiseta leidyi* seems to be confined to N. America, and *longiseta bidentata* to S. America. Whether the latter is solely prevailing in S. America, or not, remains to be investigated, as well as whether any transitional stages exist between the different races, and further, whether the different forms are in reality only races, or actually different species, or perhaps both cases are present. At present I prefer to take them as races, of the Rassenkreis *Pristina longiseta*. Whether the *Pr. longiseta* reported by JACKSON (1931) from Australia represents yet another race, or belongs to one of those reviewed above, is impossible to judge.

As to the alimentary canal of *Pr. longiseta* see the anatomical section, pp. 25—28.

Pristina longiseta longiseta Ehrenberg, 1828.

Pl. XXI, figs. 2, 6.

Pristina longiseta EHRENBERG, 1828, p. 112, foot-note.
Pristinais longiseta (Ehrenberg). GERVAIS, 1838, p. 17.
Nais longiseta (Ehrenberg). D'UDEKEM, 1855, pp. 552—553; 1859, p. 22. TIMM, 1883, p. 153.
Stylaria longiseta (Ehrenberg). TAUBER, 1879, p. 73.
Pristina longiseta Ehrenberg. VEJDOVSKY, 1883, p. 219; 1884, p. 31, Pl. II, figs. 13—15. VAILLANT, 1890, pp. 359—360 [*partim*]. BEDDARD, 1892, pp. 350—351; 1895, pp. 290—291 [*partim*]. BRETSCHER, 1896, p. 508. MICHAELSEN, 1900, p. 34; 1903 b, pp. 186—187. PIGUET, 1906, pp. 290—300, Pl. X, figs. 22—23, Pl. XII, figs. 21—25. STEPHENSON, 1909 a, pp. 264—269, Pl. XVII, fig. 25; 1910 b, p. 235; 1920, p. 199; 1922 a, p. 254. PIGUET & BRETSCHER, 1913, pp. 50—52. SCHUSTER, 1915, pp. 49—50, 76. HEMPELMANN, 1923, pp. 395—444. MALEVICH, 1927, p. 9. UDE, 1929, p. 29, Figs. 25—26. BERG, 1938, p. 45. ČERNOSVITOV, 1942 a, p. 198.
Nais proboscidea O. F. Müll. LEVINSEN, 1884, p. 219 [*partim*].
Pristina leidyi Smith. MICHAELSEN, 1905 a, pp. 357—358 [*partim*].
Pristina longiseta Ehrenberg f. *typica* Michaelsen. MICHAELSEN, 1909 a, pp. 25—26, Figs. 41—42. STEPHENSON, 1923, pp. 70—71, Fig. 23. SVETLOV, 1924, p. 197. AIYER, 1930, p. 24, Fig. 4.

[?] *Pristina longiseta* Ehrenberg. JACKSON, 1931, p. 74.
[?] *Pristina longiseta* Ehrenberg f. *typica* Michaelsen. MICHAELSEN & BOLDT, 1932, p. 595.

Hair setae 1—4 per bundle, serration close and fine; needles 2—5 per bundle, simple-pointed; ventral setae 3—9 per bundle, in II slightly longer and thinner than the rest, in III slightly longer and thicker than in the following segments, but not fewer, with distal tooth twice as long as proximal, in the rest distal tooth $^1/_3$—$^1/_2$ longer than proximal. Genital setae curved, simple (?) or with long, converging prongs, not enclosed in glands; spermathecal ampulla long, duct short; atria well-defined, glandular, duct narrow. $n = 13$—18. $s = 20$—33. $l = 3.5$—5.5 mm.

Europe, India, Australia (?).

Sweden: Waters in Småland and Närke (ALMSTEDT, 1946); pond at Karlsborg, ponds in Uppsala, Fyrisån, Ekoln, Trehörningen, Långsjön, Metsjön, Åkerö tjärn, Vallsträsket.

Pl. XXI, fig. 6 gives a complete view of a specimen from Uppsala. — The nephridial tubules were covered by bladder-like cells in my specimens, as in a *Dero*.

Pristina longiseta sinensis subsp.nov.

(= *Pr. longiseta* Ehrenberg. CHEN, 1940.)

[?] *Pristina longiseta* Ehrenberg f. *typica* MICHAELSEN, 1905 b, pp. 308—309.
[?] *Pristina longiseta* Ehrenberg. CUNNINGTON, 1920, pp. 574—575. KONDÔ, 1932, p. 388, Pl. XXIV, fig. 18.
Pristina longiseta Ehrenberg. STEPHENSON, 1931 b, pp. 41—42, Fig. 2. CHEN, 1940, pp. 46—48, Fig. 12 A, a.

Serration of hair setae close and fine, teeth 2 μ apart; needles simple-pointed. Ventral setae 5—8 per bundle, in II slightly, in III much thicker than the rest, in III also fewer, with distal tooth about 3 times as long as proximal. $n = 14$—16. $s = 15$—19. $l = 5$ mm.

China, Africa.

Pristina longiseta leidyi Smith, 1896.

(= *Pr. leidyi* Smith, 1896.)

Pristina longiseta Ehrenberg. LEIDY, 1850, pp. 44—45, Pl. II, fig. 3. VAILLANT, 1890, pp. 359—360 [*partim*]. BEDDARD, 1895, pp. 350—351 [*partim*]. HAYDEN, 1922, p. 167. ALTMAN, 1936, p. 14.
Stylaria longiseta (Ehrenberg). MINOR, 1863, pp. 38—42.
Pristina leidyi SMITH, 1896, pp. 396—402, Pl. XXV, figs. 1—6.
Pristina leidyi Smith. SMITH, 1900, p. 443. MICHAELSEN, 1900, p. 35; 1905 a, pp. 357—358 [*partim*]. MOORE, 1905 a, p. 166. GALLOWAY, 1911, p. 302. CHEN, 1940, pp. 47—48, Fig. 12 B, b.
Pristina longiseta Ehrenberg var. *leidyi* Smith. MICHAELSEN, 1905 b, p. 309. SMITH, 1918, p. 640.
Pristina tangiseta HAYDEN, 1914, pp. 136—137.
Pristina antenniseta HAYDEN, 1914, p. 137.

Hair setae 2—3 per bundle, teeth of serration far apart (6 –16 μ); needles simple-pointed; ventral setae 5—9 per bundle, in II and III slightly stouter than the rest, with distal prong 3 times as long as proximal, and with weak nodulus, not fewer in III than in adjacent segments. Genital setae long, straight with distal end bifid, resembling that of ordinary setae; enclosed within genital glands; spermathecal ampulla short, duct short; atria not distinguishable from vasa deferentia, muscular (?). $n = 14—25$. s (mature) $= 30$. $l = 4—8$ mm.
N. America.

The two species *Pr. tangiseta* Hayden and *Pr. antenniseta* Hayden no doubt belong here, as there seem to be no differences at all. *Pr. antenniseta* is stated to have testes and spermathecae in VI, ovaries in VII, and "seminal vesicles" in V, but this remarkable statement was no doubt due to some misunderstanding.

Pristina longiseta bidentata Černosvitov, 1942.

(= *Pr. longiseta* var. *bidentata* Černosvitov, 1942.)

[?] *Pristina leidyi* Smith. MICHAELSEN, 1905 a, pp. 357—358 [*partim*].
[?] *Pristina longiseta* Ehrenberg f. *typica* Michaelsen. MICHAELSEN, 1913, pp. 208—209; 1921 b, p. 2. CORDERO, 1931, p. 350.
[?] *Pristina longiseta* Ehrenberg. PIGUET, 1928, p. 91.
Pristina longiseta Ehrenberg var. *bidentata* ČERNOSVITOV, 1942 a, pp. 198—199, Figs. 1—15.
Pristina longiseta Ehrenberg f. *typica* Michaelsen. MARCUS, 1943, pp. 107—109, 116—125, Pl. XX, fig. 80, Pl. XXI, fig. 84, Pl. XXII, fig. 93, Pl. XXIII, Pl. XXIV, fig. 95, Pl. XXV, fig. 100.

Hair setae 1—3 per bundle, closely and finely serrated; needles 1—5 per bundle, extremely finely bifid; ventral setae 3—5 per bundle in anterior segments, up to 13 in posterior, in II considerably longer and thicker than the rest, with distal prong twice as long as proximal, in III slightly longer and thicker than in the following segments, with distal prong 1 $^1/_2$ as long as proximal; in the other segments prongs about equally long. Genital setae long, straight, bifid like ordinary setae, not enclosed within glands; spermathecal ampulla small, duct long; atria very small and narrow; behind atria, a pair of glandular masses. $n = 13—23$. $s = 20—33$. $l = 2—12$ mm.
S. America.

MARCUS (1943) described an "antero-dorsal organ" in this form.

Pristina biserrata Chen, 1940.

Pristina biserrata CHEN, 1940, pp. 49—52, Figs. 13—14.

Prostomium forming a proboscis. Hair setae 1—3 per bundle, serrated, in II—VII shorter, in all others exceedingly elongated; ventral setae in II—VII 4—6 per bundle, thinner than the rest, in II slightly longer and thicker than in III—VII, in the following segments 10 per bundle, thick. Septal glands in IV—V. Commissural vessels in II—IX. Clitellum in $^1/_2$ VII –IX; genital setae in VI, 3 per bundle, long, proximal prong disappearing; a pair of glandular masses behind the genital setae; spermathecal ampulla large, duct short; male funnels large, vasa deferentia glandular, with prostate covering, atria small but distinct, without prostate cells, duct short, narrow. $n =$ 15—16. $l =$ up to 12 mm.

E. Asia (China).

The hair setae are stated to be 0.5—1.1 mm long behind VII, with teeth 8 μ apart, their base ensheathing more than half the circumference of the seta. There are stated to be no needles, only 2—6 very short hairs, but probably these are thin and simple needles — CHEN does not report needles in *Pr. longiseta* or *proboscidea* either, where they are certainly present. The posterior ventral setae are stated to be 80 μ long, 3.5 μ thick.

This species is no doubt very closely related to *Pristina longiseta*, as is shown by the similar arrangement of the sexual organs; the extreme length of the hairs is, however, a good distinguishing character; also, the vasa deferentia seem to have a prostate covering in the present species.

Pristina proboscidea Beddard, 1896.

Pristina proboscidea Beddard, 1896, p. 4, Fig. 18.

Pristina aequiseta Bourne. MICHAELSEN, 1900, p. 34 [*partim*]; 1905 b, pp. 309—310 [*partim*].

Pristina proboscidea Beddard f. *typica* MICHAELSEN, 1905 a, pp. 359—360.

Pristina proboscidea Beddard var. *paraguayensis* MICHAELSEN, 1905 a, pp. 360—361.

Pristina aequiseta Bourne var. *paraguayensis* (Michaelsen). MICHAELSEN, 1905 b, p. 309.

[?] *Pristina serpentina* WALTON, 1906, pp. 701—702, Fig. 11.

Pristina proboscidea Beddard f. *typica* Michaelsen. MICHAELSEN, 1909 b, pp. 133—134. STEPHENSON, 1911, pp. 211—212; 1923, p. 73. MICHAELSEN & BOLDT, 1932, p. 595. ČERNOSVITOV, 1937 b, p. 136. CHEN, 1940, p. 49.

Pristina proboscidea Beddard var. *paraguayensis* Michaelsen. MICHAELSEN, 1909 b, p. 134. STEPHENSON, 1923, pp. 73—74. AIYER, 1930, pp. 26—27, Fig. 6. MICHAELSEN & BOLDT, 1932, p. 596.

Pristina proboscidea Beddard. MARCUS, 1943, pp. 111—112, Pl. XXI, fig. 87, Pl. XXII, fig. 88.

Prostomium forming a proboscis. Hair setae serrated, 1—4 per bundle, none especially elongated; needles 1—4 per bundle, simple-pointed, straight and fine, without nodulus; ventral setae in anterior segments 2—4 per bundle, up to 9 posteriorly, all of one type, with distal prong longer than proximal, in II longer and thicker than the rest. Septal glands in III—V. Free commissural vessels in II—VII, enlarged in VI—VII. $n =$ 16—24. $s =$ 18—36. $l =$ 2—5 mm.

S. America, Zanzibar, S. and E. Asia.

The present species was described very incompletely by BEDDARD from Chile (1896), but MICHAELSEN (1905 a) redescribed it from BEDDARD's original material, and specimens from Paraguay and Java. It was frequently confused with *Pristina aequiseta* Bourne, though the two species must be easily recognizable, *Pr. proboscidea* having simple needles and all ventral setae alike, *Pr. aequiseta* bifid needles, ventral setae abruptly changing type behind VII, and usually also the giant setae in IV or V. Michaelsen described one f. *typica* with finer serration, about 6 μ between the teeth, and hairs about as long as the body diameter, and one var. *paraguayensis* with teeth of hairs 11 μ apart, and length up to 3 times the body diameter. He speaks, however, about transitional types, and Aiyer, for instance, gives the distance between the teeth in the variety as 6.5—9 μ, Marcus in the typical form as up to 11 μ. The length of the hair setae apparently also varies very much, so that there is a whole scale of transitions for both characters, in various regions. Thus, the typical form is reported from Chile, Argentine, Paraguay, Brazil, Zanzibar, British India, Sumatra, Java, and China, the variety from Paraguay, British India, and Sumatra. So there can be no question about the types representing geographical races.

The setal measurements in *Pr. proboscidea* as stated in the literature are: hairs up to 620 μ, needles about 50 μ, ventral setae in II 78—108 μ long, 3 μ thick, in the other segments 58—80 μ long, 1.5—2 μ thick.

Possibly *Pristina serpentina* Walton (1906) may belong here. It is stated to have 3 serrated hairs, and 2—6 simple-pointed needles, 30—50 μ long, per bundle dorsally, and 5—6 setae, 60—80 μ long, with subequal teeth ventrally. $l = 2.2$ mm. Walton remarks that the form of the distal tooth of the ventral setae distinguishes it from *Pr. proboscidea*. This is true, as the latter has the distal prong longer, but the difference is small, and W.'s description is very superficial. Another difference, not stressed by W., is the length of the hairs in II, which are figured somewhat longer than in the following segments, while in all other species known they increase in length from II on, when no especially elongated setae are present in some segment.

Pristina macrochaeta Stephenson, 1931.

Pristina macrochaeta Stephenson, 1931 c, pp. 299—301.
Pristina macrochaeta Stephenson. Marcus, 1943, pp. 109—110, Pl. XXI, fig. 85, Pl. XXII, fig. 86.

Prostomium forming a proboscis. Dorsal setae beginning in III or IV, hair setae very stout, serrated, 1—4 per bundle; needles simple-pointed, 1—3 per bundle; ventral setae 5—10 per bundle, in II longer than the rest, all of similar type, with distal prong longer than proximal. Septal glands in III—V or IV—VI. Enlarged vascular commissures in VI—VII. $n = 10$—16. $s = 21$. $l = 3.8$—7 mm.
S. America.

The hairs are stated to be 160—630 μ long, and 3—4 μ thick, with teeth up to 12 μ apart, the needles 60 μ, the ventral setae in II 107—112 μ, and the rest 70—90 μ long. — According to MARCUS the species has an "antero-dorsal organ" with probably mechanical functions.

This species very much resembles *Pr. proboscidea*, except that dorsal setae are lacking in one or two anterior segments, a condition which is so far unique in the genus.

*

Several species of *Pristina* or "*Naidium*" have been described, the place of which is partly uncertain. *Naidium palméni* Munsterhjelm (1905) is no doubt a Tubificid. Thanks to the authorities of the Zoological Museum at Helsinki I have had opportunity to examine MUNSTERHJELM's material, and could satisfy myself that the species does not belong to the *Naididae*. The material contained several dozen specimens, none showing any sign of budding. The setae were normal Tubificid setae, and the needles resembled the posterior bifid needles of a *Tubifex*. The dorsal setae begin in III, as M. stated, but this ought not to be an obstacle for its belonging to the *Tubificidae*.

The*? Naidium sp.* Ward (1905) seems also to be most probably a Tubificid, showing no signs of budding. It does not seem to be identical with the previous, although the dorsal setae begin in III, for it is much smaller, less than 3 mm (*N. palméni* up to 15 mm), and the prongs of the ventral setae are stated to be very unequal in length (in *N. palméni* the distal prong is slightly shorter).

Naidium dadayi Michaelsen (1905) is probably no *Pristina*, as the ventral setae abruptly change appearance in VI, which indicates that 5 segments are formed in a budding-zone. From the scanty description it is impossible to judge its place in the family.

Pristina papillosa Černosvitov (1935) is a very curious species. It was found in salt water, in the Black Sea, and described from 3 specimens, none showing budding. From XIII onwards the skin is covered by granular gland cells. Both the bifid needles, and the hairs are abruptly bent about their middle. It seems most probable that this species also belongs to the *Tubificidae*.

As to *Nadium luteum* Schmidt, see p. 210.

Pristina flagellum Leidy (1880) was transferred to a family of its own, *Opisthocystidae*, by ČERNOSVITOV (1936), on account of the sexual organs, which are found in XXI—XXIII, the spermathecae behind the gonads (cf. p. 266).

*

Like several other authors I have referred all species described under the names *Pristina* and *Naidium* to *Pristina*, since there seems to be no possibility of making a distinction. Different authors have used different characters in trying to separate them. Piguet (1906, 1909) divides the genus solely on the occurrence of bifid needles, and thus gets *Pristina foreli* and *aequiseta* (= *Naidium tentaculatum*, Piguet, 1906) under *Naidium*. Others, e. g. Stephenson, have used the presence of a proboscis as the crucial character of a *Pristina*, but in this case several species present difficulties; *Pr. breviseta* may have a short proboscis, but may also lack it, and the short proboscis in *Pr. synclites* and *peruviana*, and in some cases in *Pr. foreli* (cf. Piguet, 1906), is apparently only a step from the pointed prostomium in e. g. *Pr. jenkinae*. Besides, this seems a fairly artificial character.

Piguet (1928) unites *Pristina* and *Naidium*, but adds: "Il y a pourtant, entre un *Naidium* typique tel que *N. roseum* et des *Pristina* incontestées telles que *P. longiseta* et *P. aequiseta* une différence en quelque sorte physiologique, ces *Pristina* étant des Vers fins, élégants et transparents, à tissues délicats, à sang d'un jaune pâle, à trompe éffilé; tandis que *N. roseum*, qui se présente à prémière vue comme un jeune *Tubifex*, est plus robuste, plus opaque, à sang rougeâtre, à lobe céphalique arrondi au bout et sans aucune indication d'éffilement en trompe." He is undoubtedly right that the extremes mentioned are well distinguished from each other, but the occurrence of a lot of intermediate forms, such as *Pr. breviseta* with or without a proboscis, reddish, but with movements like a *Pristina*, makes it very difficult to fix a border line.

Marcus (1944) recognizes the difficulties; yet he retains the subdivision, chiefly on account of the differences between the genital organs of "*Naidium*" *breviseta* and the others. He includes even such a typical *Pristina* as *Pr. foreli* under *Naidium*.

A suggestion by the late Dr. Černosvitov (*in litteris*) to divide the genus on the occurrence of intracellular canals in the stomach, breaks down on the fact that really all species seem to possess such canals; at least the canals exist e. g. in *Pr. amphibiotica* and *idrensis*, which are in other characters typical "*Naidium*", with a rounded prostomium, opaque body, and slow movements.

Nevertheless some groups are distinguishable within the genus. One is formed by the species *longiseta*, *biserrata*, *proboscidea*, *foreli*, *macrochaeta*, *aequiseta*, and *evelinae*. They all usually have a well-defined proboscis, the stomachal dilatation is very sudden, and normally situated in VIII, and there are free commissural vessels in the anterior segments. Some setal characters distinguish these species from all the rest. Thus, the needles are very fine, much thinner than the hairs, and straight or faintly curved, without a nodulus. They are simple-pointed, or extremely finely bifid. The ventral setae of II differ in shape from the rest, being longer, straighter, and either finer or stouter than these, with the nodulus proximal or median instead of distal, and with a greater difference in length between the prongs. The ventral setae behind III show a faint gradual transition in shape (except in *Pr. aequiseta*), the nodulus getting more and more distal, and the distal tooth shorter backwards.

The sexual organs, as far as they are known, also have certain traces in common; thus, the vasa deferentia are strongly glandular, the atria more or less small, no penial setae are present, but genital setae in VI, surrounded or preceded by genital glands. Among these, *Pr. aequiseta* and *evelinae* form a group by themselves, having giant setae in IV or V (in *Pr. aequiseta* the ventral setae abruptly change shape in VIII).

Compared with these species all the rest have much stronger needles, approaching the hairs in thickness, with a more or less well-defined nodulus, and distally of this a bayonet-shaped curve. The teeth are often very long. The ventral setae are shortest in II, resembling the others in shape, and gradually increasing in length backwards in the anterior segments, like the normal dorsal setae in all the species. The transverse commissural vessels in some of the foremost segments usually form a plexus, though there are exceptions.

Among these one group can be distinguished, consisting of *Pr. americana*, *plumaseta*, *synclites*, *peruviana*, and *breviseta*. They have very stout needles, with long teeth, 6—12 μ (*Pr. plumaseta*?). The sexual organs, as far as known, have certain characters in common, which distinguish them from the fore-going group. Thus, the atria are usually long (small in *Pr. plumaseta*), and penial setae are present, besides the genital setae in VI (or VII). In *Pr. breviseta*, both sorts resemble those of *Pr. longiseta*, but in the other species of the group with known sexual organs (*Pr. americana* and *plumaseta*) they are shaped otherwise, the penial setae being alike in these species. Other characters, proboscis, commissural vessels, etc. vary in the group. The bulk of this group and the above-mentioned, form what has usually been conceived as "*Pristina*".

The remaining species all lack a proboscis, and, as far as is known, are more opaque, and have slow movements. The needles usually have not such long teeth as in the last-mentioned group (except *Pr. jenkinae*). usually about 2—4 μ. The ventral setae show the same characters as in the second group. The conditions of the vascular system vary, and the sexual organs are mostly unknown. The group is not sharply differentiated from the fore-going. *Pr. jenkinae* forms an intermediate, and *Pr. menoni*, if my specimens (p. 213) really belong here, is fairly opaque, but is stated by AIYER (1930) to move like a *Pr. breviseta*, which moves like a "*Pristina*". As to *Pr. jenkinae*, *minuta*, *sima*, *bilobata*, and *notopora*, nothing seems to be stated about the general habit. *Pr. rosea*, *amphibiotica*, and *idrensis* seem to be the most typical "*Naidium*", with opaque, tapering bodies, and sluggish, Enchytraeid-like movements.

Pr. amphibiotica and *idrensis* stand a little apart from the rest of the group, having the stomach beginning in VI, instead of VII or VIII, as in all the others, and probably in the rudimentary state of their sexual organs (not known in the other species of the group). Yet, the shape of the penial setae, when present — wholly similar to the genital setae of *P. longiseta longiseta* and *P. breviseta* — shows that there is no essential difference between these species and the fore-going groups, which would justify their generical separation. The division into subgenera may well be desirable in the future when some more of the species become better known, and a division could be made with a higher degree of certainty than at the present.

It seems apparent that the first of the groups contains the most specialized forms, with the ventral setae of II differing from the rest, and a proboscis (and hair-like needles; cf. p. 255). In all probability the forms of the *rosea*-group are more primitive in these respects.

IV. Phylogenetical discussion.

Interrelations of the genera.

Attempts have been made by various authors to subdivide the *Naididae* into natural groups. Thus, CZERNIAVSKY (1880) separated *Dero* (including *Aulophorus*) from the rest as the family *Branchinaididae*. The *Naididae*, according to him, included *Nais*, *Stylaria*, *Pterostylarides* (= *Ripistes*), *Paranais* (= *Paranais* + *Uncinais*), and *Chaetogaster*, together with a couple of genera not actually belonging to the family.

VEJDOVSKY (1884), on the other hand, separated *Chaetogaster* as the family *Chaetogastridae* from the other genera, which were united in the family *Naidomorpha*.

VAILLANT (1890) united the *Tubificidae* and *Naididae* into one family, *Naididae*, with the groups *Tubificinea* and *Naidinea*, but he did not subdivide the groups.

KALLSTENIUS (1891) followed VEJDOVSKY, and added the genus *Amphichaeta* to the *Chaetogastridae*.

STIEREN (1892) subdivided the *Naidomorpha* into three subfamilies: the *Cilionaididae* with *Aulophorus* (including only *A. discocephalus* Schmarda; the erection of this subfamily was based on the misconception by Schmarda that the species in question had a ciliated prostomium), the *Branchinaididae* (after Czerniavsky) with *Dero*, *Chaetobranchus* (= *Branchiodrilus*), and the gill-bearing Microchaetide genus *Alma*, and the *Naididae* with the rest of the genera.

Michaelsen (1900) re-united all the genera, including *Chaetogaster* and *Amphichaeta* into the *Naididae*, without any subdivision. Later (1928) he united the *Naididae* with the *Aeolosomatidae* to form the "Familienreihe" *Naidina.*

Lastočkin (1924 a) separated *Pristina* (including "*Naidium*") as the sub-family *Pristininae* from the *Naidinae*, including the rest of the family in the sense of Michaelsen.

Stephenson (1930) attempted no subdivision, yet stressed his opinion of the closer relation between some of the genera: *Paranais* (including *Uncinais*) and *Amphichaeta* (cf. below); *Nais*, *Stylaria*, *Slavina*, *Ripistes*, *Vejdovskyella*, and *Ophidonais.* He emphasizes, that if a division into subfamilies is undertaken, *Chaetogaster* (possibly with "*Schmardaella*") ought to be separated from the remaining genera.

*

The two genera *Chaetogaster* and *Amphichaeta* undoubtedly form a group by themselves, distinguished from all the others by a number of peculiar characters. These are a strongly lengthened pharynx, without any dorsal diverticulum, and without any gland cells, connected with the body-wall by numerous radial muscular strands; a short, narrow oesophagus; a stomach with a peculiar structure, sharply marked off from both oesophagus and intestine; a strongly reduced vascular system; and closed nephridia. Hair setae, eyes, and prostate are absent in both, and the general shape and structure of the genital organs is much the same. The dorsal setae are wholly absent in *Chaetogaster*, but in *Amphichaeta* they are present from III onwards, so here the initial stage of the reduction has apparently been preserved. In *Chaetogaster* the ventral setae of III—V have been lost, too, the septa are strongly perforated, and there is often a statocyst in the brain. The latter in most species, but not in the primitive ones, is considerably simplified, and the nerve-cord in the anterior segments is rope-ladder-formed, the two components not having fused. In *Amphichaeta*, on the other hand, the brain has one anterior, median lobe, there are no penial setae, and the nephridia are sometimes packed against the ventral vessel. Stephenson (op. cit., p. 730) did not consider the two genera allied; he remarks that the sole character peculiar to both is the absence of nephridial funnels, and regards *Amphichaeta* as the nearest relative of *Paranais* (in the old sense), because of the presence of only double-pronged crotchets dorsally and ventrally. This is quite an untenable position; as has been shown before (p. 82) the old genus *Paranais* really consists of at least three different genera, not especially related to each other. In fact, *Chaetogaster* and *Amphichaeta* seem without doubt to form a group less related to the rest of the family than any of the other genera. All the latter possess a ciliated dorsal pharyngeal diverticulum with gland cells, oesophageal or septal glands, an oesophagus occupying several segments, several transverse vessels (or a plexus), and nephridial funnels (except *Paranais*, which lacks nephridia). It seems most probable that the *Chaetogaster* — *Amphichaeta* stem branched off very early from the common Naid trunk, and their comparatively independent position should be stressed in some way. Like some of the above-mentioned authors (p. 244) one might separate the two genera from the other *Naididae* as one family, *Chaetogastridae*. This, on the other hand, seems a little exaggerated, as the sexual organs are situated in the usual place and order, budding is present, and all the special features can easily be conceived as specialized Naid characters. Therefore I regard it as most convenient to let them form the subfamily *Chaetogastrinae*.

Stephenson has repeatedly (e. g. 1913 b, 1930) expressed his opinion of the genus *Chaetogaster* as descended from endoparasitic forms. The absence of dorsal setae, "the absence of ascending ciliary action and antiperistalsis in the intestine . . ., the reduction of the vascular system, the absence of complete dissepiments, and consequently of sperm-sacs and ovisacs, the generally carnivorous habit, the thinness of body-wall and consequent transparency, and the sometimes commensal and epizootic mode of life" are pointed out as indications of this. When *Amphichaeta* is considered, however, the first argument must be excluded. The reduction of the vascular system is confined to the strongly modified pharyngeal region, and the septa, if more perforated than usual, are still quite recognizable (septum 3/4 is unusually strong). None of these characters, or the others mentioned, suggest parasitism. (As regards the transparency, it may be pointed out that the commensal, *Ch. limnaei*, is the least transparent species.) Thus, it seems apparent that the mode of living cannot have been the cause of the peculiarities of the two genera.

The genus *Paranais* also deviates strongly from the rest of the family. Thus, nephridia are wholly absent, a unique character; they are not even transitionally formed in budding segments. Only 4 segments are formed anteriorly by budding instead of the usual number of 5. It is true that 4 segments are formed in *Stephensoniana*, too, but this genus is otherwise so unlike *Paranais* that they can hardly be supposed to be especially related to each other (cf. below, p. 254). The genital organs (Fig. 27 *D*, p. 251) are also peculiar in several respects; the vasa deferentia are extremely narrow, and the atria have an unusually, sometimes even excessively, strong muscular layer (and there is no prostate). The ejaculatory ducts are long and well-defined, but their epithelium is not columnar, and the clitellum is thick and strong round and between their openings, not absent or weak, as is usually the case. The penial setae in some cases wholly resemble ordinary ventral setae, which is probably a very primitive character (cf. p. 52). There are no hair setae (and no eyes, which is, however, the case in many other genera, too), and the needle setae wholly resemble the ventral ones. Septal glands are present, which are not likely to have anything directly to do with those of *Dero* or *Pristina*. The genus certainly must be very old, and seems to me to warrant the erection of a special subfamily, the *Paranaidinae*.

The large and extremely varying, yet curiously homogeneous genus, *Pristina* also ought to be considered as a subfamily, as was done by Lastočkin (1924 a). 7 segments are formed at the anterior end in a budding-zone. The dorsal setae begin in II (except in one species, where they have certainly got lost secondarily in II—III), the needles show a variety of forms, from stout bifid ones with extremely long teeth and a nodulus, to fine, hair-like ones. All the forms seem to possess the characteristic stomach, with cells containing intra-cellular canals with special features, and septal glands of a shape and structure different from those of *Dero* and *Paranais*, being closely-packed organs of a definite shape, connected by strands with the pharynx. The genital organs show a rich variety of forms, yet the atria are always narrow, non-glandular, without prostate, the vasa deferentia entering on top. The genital setae, penial and spermathecal, show several peculiar forms, all confined to the genus.

The remaining *Naididae* form the subfamily *Naidinae*, which is more heterogeneous than the fore-going ones. Here some groups of genera distinguish themselves from the others.

Thus, the genera *Stylaria*, *Arcteonais*, and *Ripistes* are obviously very closely related to each other. Apart from the common family characters (p. 57), and other characters common to a more or less large part of the family, such as the formation of 5 anterior segments in a budding-zone, commissural vessels in II—V (or some of these), either simple or slightly branching, a median dorsal vessel, normally eyes, the dorsal setal bundles beginning in VI, with fine, hair-like needles, penial setae with a simple distal hook and a nodulus, the absence of the clitellum between the male pores, and vasa deferentia opening into the atria in the vicinity of the ejaculatory duct, they have several peculiar characters mainly to themselves. All three genera have a more or less pronounced proboscis, and a suddenly dilating stomach (most conspicuous in *Stylaria*). The mode of swimming (not known in *Arcteonais*) is unique in the family: the movements are made in the sagittal plane (cf. p. 38). In *Arcteonais* and *Ripistes* the dorsal setal bundles, or certain of them, contain a large number of setae. In these two genera the shape of the atria and the distribution of the prostate gland cells are also peculiar. The atrial ampulla is strongly reflected backwards; its epithelium is thick and glandular, except in the posterior wall, where it is thin and non-glandular. Thickly-set prostate gland cells cover the foremost part of the ampulla; farther backwards they become scattered, and the posterior wall is wholly devoid of prostate. The vasa deferentia, opening immediately above the atrial ducts, are devoid of prostate (Fig. 26 *C*) but the epithelium is somewhat glandular (Pl. IX, fig. 5). In *Stylaria* there are few setae in the dorsal bundles, but the peculiarly shaped ventral setae are somewhat reminiscent of the ventral setae behind II in *Ripistes* (cf. Fig. 15 *K*, *L*, p. 145); the ventral setae of *Arcteonais* resemble those of II in *Ripistes* (Fig. 15 *G*, *H*). — The atrial ampulla of *Stylaria* is wholly glandular and covered with thick prostate, but the spermathecal duct is well-defined, consisting of columnar cells, as in the two other genera.

The two genera *Vejdovskyella* and *Slavina* are no doubt closely related to each other and to the *Stylaria* group. They have several of the common characters referred to above (the commissural vessels, however, form a plexus in *Slavina*, and here, too, the needles are more "needle-like," with a minute fork or expansion distally. In *Vejdovskyella* the hairs are very stout and roughly serrated). Both genera contain species with the dorsal setae beginning one or two segments in front of VI. In both, the stomachal dilatation is generally slow. One of the features which they have in common is the shape of the sexual organs. The spermathecal ducts are very long and well-defined, with a columnar epithelium. The shape of the atria, and the distribution of the prostate agree wholly with the conditions in *Arcteonais* and *Ripistes*, which are not found in any forms other than these four (Fig. 26 *A*, *B*). This strongly suggests a particular relationship between the genera of the *Stylaria* group, and *Vejdovskyella* and *Slavina*. Also, the mode of fission (the "type stylarienne", Dehorne, 1916) is the same in the *Stylaria* group and at least *Vejdovskyella intermedia* (cf.p. 140; in *Slavina* it does not seem to have been observed).

In the primitive condition common to these five genera, eyes ought to have been present, but no proboscis, as the elongation of the prostomium must be assumed to be secondary; the dorsal bundles probably began in IV (cf. p. 254), the needles being fine, either simple-pointed or finely bifid, without a nodulus. The stomachal dilatation was probably slow, for the large, abruptly dilated stomach is reasonably a specialization. As the ventral setae are all of one type throughout the body in most of the species, this ought to have been the primitive condition. The atria have apparently been provided with prostate, but not the distally opening vasa deferentia. The spermathecal duct was well-defined, with a high epithelium. (Of

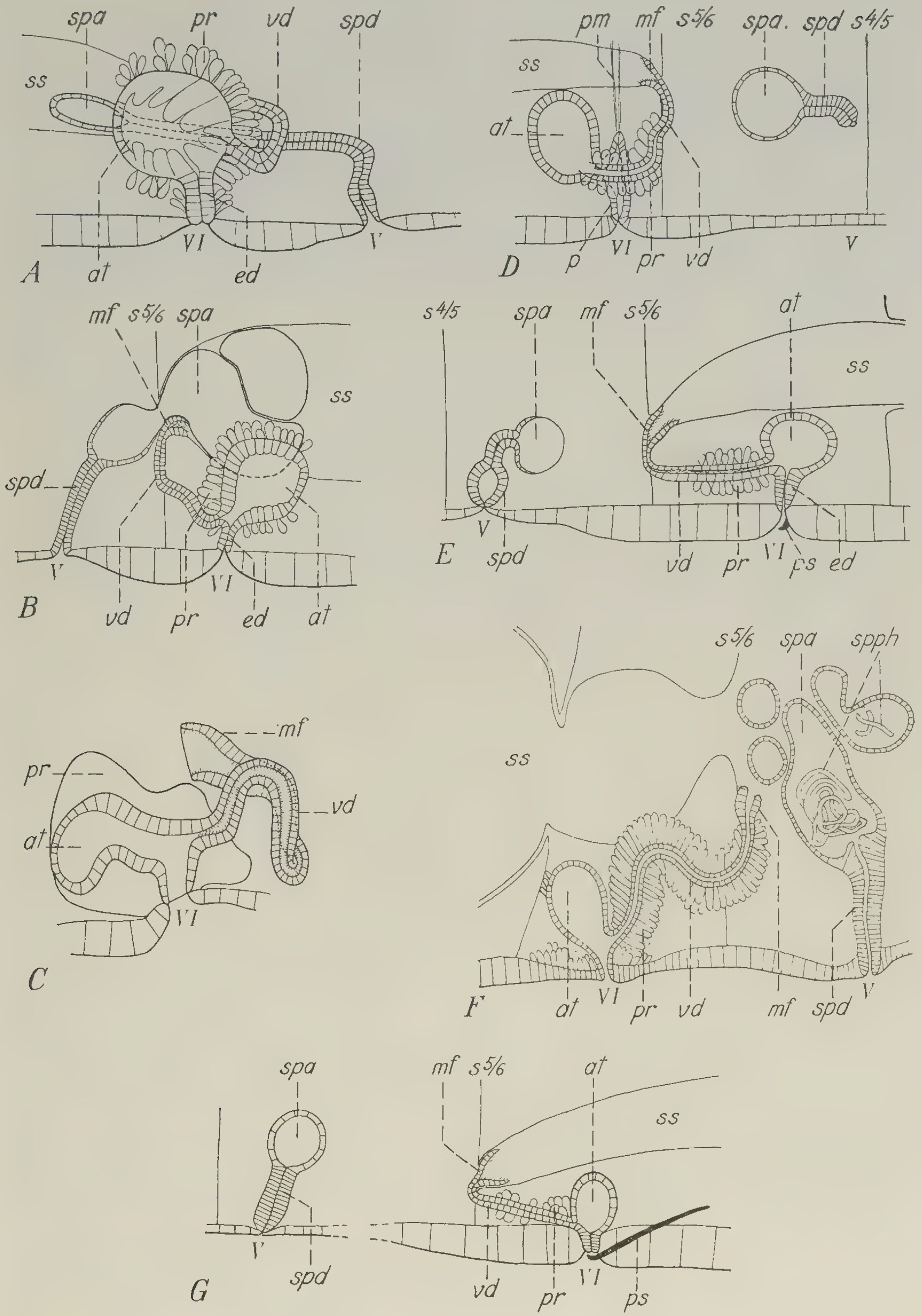
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Fig. 26. Genital organs, diagrammatic. *A Ripistes parasita* (male efferent apparatus), *B Slavina appendiculata*, *C Vejdovskyella comata*, *D Specaria josinae*, *E Nais simplex*, *F Ophidonais serpentina*, (after PIGUET, 1906), *G Uncinais uncinata*. (Legends p. 290). *A*, *C* 300 ×, *B*, *D*, *G* 150 ×, *E* 180 ×, *F* 130 ×.

course, the ancestral form may have been still more primitive in some respects, but this cannot be deduced from the available facts.)

Another natural group is formed by the genera *Nais*, *Ophidonais*, and *Uncinais*. They have dorsal setae beginning in VI, and the two latter genera have ventral setae of one type throughout the body (and no hair setae). The sexual organs in all three genera are of the same type (Fig. 26 *E—G*); the vasa deferentia are provided with prostate glands, but not the atria, and the former open into the latter immediately above the beginning of the ejaculatory duct. The spermathecae also have well differentiated ducts, with a columnar epithelium (this character is common to most genera). They have many characters in common with the *Slavina-Stylaria* group, in addition to the point of opening of the vasa deferentia into the atria, such as the presence of eyes, commissural vessels in the anterior segments only, absence of the clitellum between the male pores, and penial setae of the common type, with a simple hook. In *Nais* and *Ophidonais* the commissural vessels are fairly simple, in *Uncinais* they form a plexus. Which of the three genera stand closest to each other seems impossible to judge. It seems that to this group may suitably be joined the genus *Specaria*. Here, too, the vasa deferentia are provided with prostate, but not the atria, and the epithelium of the latter is not, or at the most very faintly, glandular (cf. p. 97). Also, the vasa deferentia open into the atria immediately above the atrial duct, and the spermathecal ducts are well-defined and consist of columnar cells (Fig. 26 *D*). The ventral setae are all of one shape, as in *Ophidonais* and *Uncinais*, the dorsal setae approaching in shape the most primitive *Nais* type. The vascular system in I—V forms a plexus, as in *Uncinais*. The peculiarities of the sexual organs, however, (atrial pockets and laterally opening spermathecae) together with the presence of an additional pair of transverse vessels (in VI), and the absence of eyes (which may, however, have been lost secondarily) indicate a certain remoteness of this genus from the rest of the genera of this group.

The primitive condition in the group *Nais-Ophidonais-Uncinais-Specaria* may be assumed to have been characterized by non-differentiated ventral setae, a slowly widening stomach, and vasa deferentia joining the atria near the atrial duct, as was assumed for the *Slavina-Stylaria* group, but prostate cells on the vasa deferentia instead of the atria. The needles were no doubt biuncinate, with a nodulus, but whether shaped as in *Nais communis*, for instance, or in *Uncinais*, cannot be judged from the above genera only. The dorsal setae will have been present from VI onwards. Eyes may have been present, or absent and developed within the group.

The genus *Piguetiella* has many important features in common with the *Slavina-Stylaria* group. The commissural vessels, present only in the

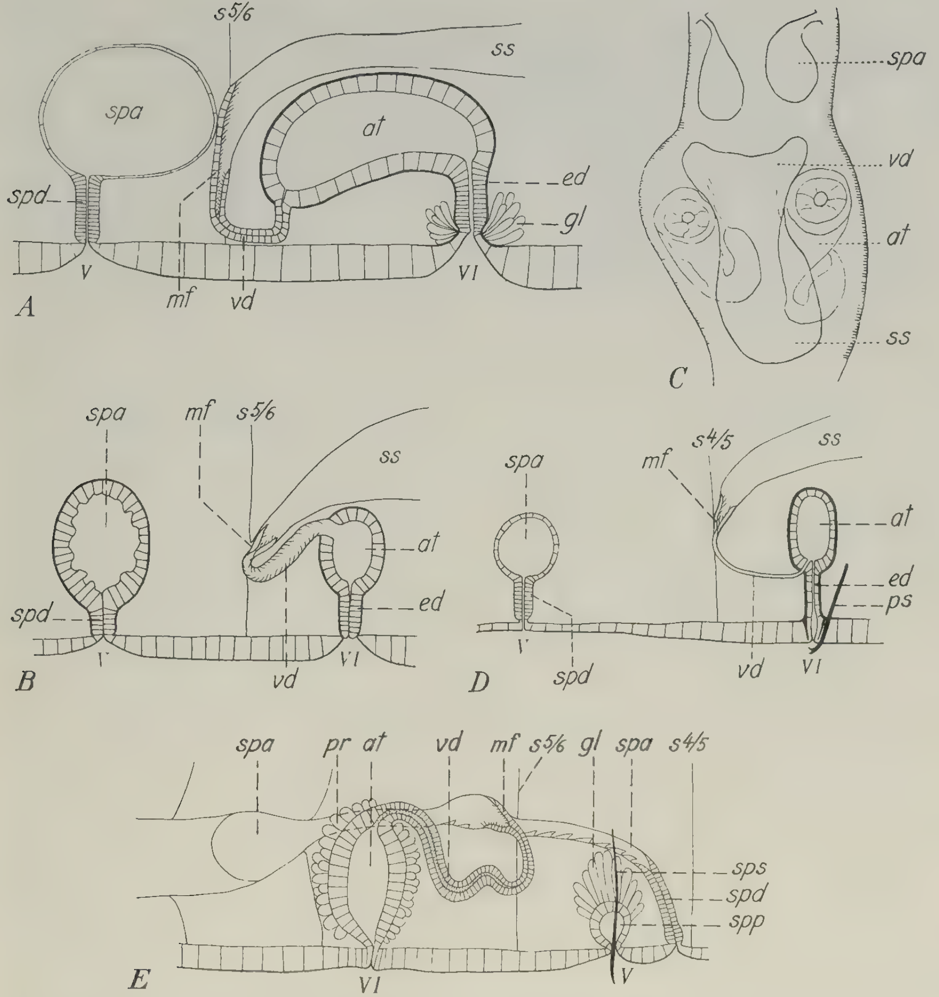
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Fig. 27. Genital organs, diagrammatic. *A Dero digitata, B Haemonais waldvogeli* (reconstruction after STEPHENSON, 1915 a, *H. "laurentii"*) *C, Homochaeta setosa* (from MOSZYNSKI, 1933), *D Paranais botniensis, E Piguetiella blanci.* (Legends p. 290). *A, D, E* 150 ×, *B* 120 ×.

first 5 segments, are quite simple, as in this group, and the genital organs agree in many points. Thus, the vasa deferentia are somewhat glandular, but devoid of prostate, whereas the atria have a thick prostate, as in *Stylaria*. The spermathecae are very long, with a long, well-defined duct. Eyes are also present. It is true that this is the case in the *Nais* group too, and that in this group the needle setae are in one genus similar to the ventral setae, as in *Piguetiella*, and these facts might make a connection between this group and *Piguetiella* seem perhaps more probable. The distribution of the prostate, however, seems to me to argue strongly against such an assumption. If *Piguetiella* were more closely related to the *Nais* group, it must be assumed to have dropped an already developed prostate on the vasa deferentia, and aquired another on the atria, which seems to me less probable. On the other hand it has developed some peculiar characters of its own, namely the spermathecal setae and the glandular pockets connected with these, and the vasa deferentia open into the top of the atria instead of into the distal end, so the relation with either group cannot be very close.

The remaining members of the family, the genera *Homochaeta*, *Haemonais*, *Branchiodrilus*, *Dero*, *Allonais*, and *Stephensoniana*, all lack eyes, the vasa deferentia generally do not open distally, and, with the exception of *Stephensoniana* (see below), there are no prostate gland cells (except in the deviating *Dero evelinae*) and a vascular plexus is found in the anterior segments. Among these, *Dero* and *Allonais* bear a certain resemblance to each other (cf. p. 208). They have atria and spermathecae with well-defined ducts with a high epithelium (Figs. 27 *A*, 28 *B*). The usual state of the vascular system in *Allonais* (*A. pectinata* is not considered here, cf. p. 207) is similar to that prevailing in *Dero*, with an anterior plexus, and segmental loops in a number of segments behind. In *Aulophorus superterrenus* there are loops in all segments behind the plexus; in *Allonais chelata* in nearly all. Also, the dorsal vessel runs ventrally to left in at least a couple of *Allonais* species, as it does in *Dero*. The ventral setae of II—V in *Allonais* are only faintly differentiated from the rest, as in primitive *Dero* (e. g. *Allodero*, *Dero dorsalis*, *Aulophorus superterrenus*) and various types of pectinate needles occur in both genera, but in no other. The medially opening ventral gland cells in II—V found by MARCUS (1943) in *Allonais paraguayensis*, *Dero evelinae*, *Aulophorus carteri*, *A. furcatus* and *superterrenus*, also indicate a certain relationship between the two genera.

It is difficult to find any connections for the rest of the genera. *Homochaeta* appears to be fairly isolated. It has no hair setae, with the dorsal setae, beginning in II, wholly resembling the ventral setae, which are of one type throughout the body. The atria and spermathecae (in the only case known) open directly outwards, without any ducts (Fig. 27 *C*), and the penial setae wholly resemble ordinary setae. *Haemonais* shows some resemblance to *Homochaeta*, in so far as the dorsal setae begin in II in one form, and the needle setae are fairly crotchet-like. On the other hand the differences are great; thus, the ventral setae are differentiated into two types in *Haemonais*, the atria and spermathecae have well-differentiated ducts with a high epithelium (Fig. 27 *B*), and there are vascular loops in each segment of the body, behind the anterior plexus, and extra complications in the form of additional vessels and anastomoses, and two different

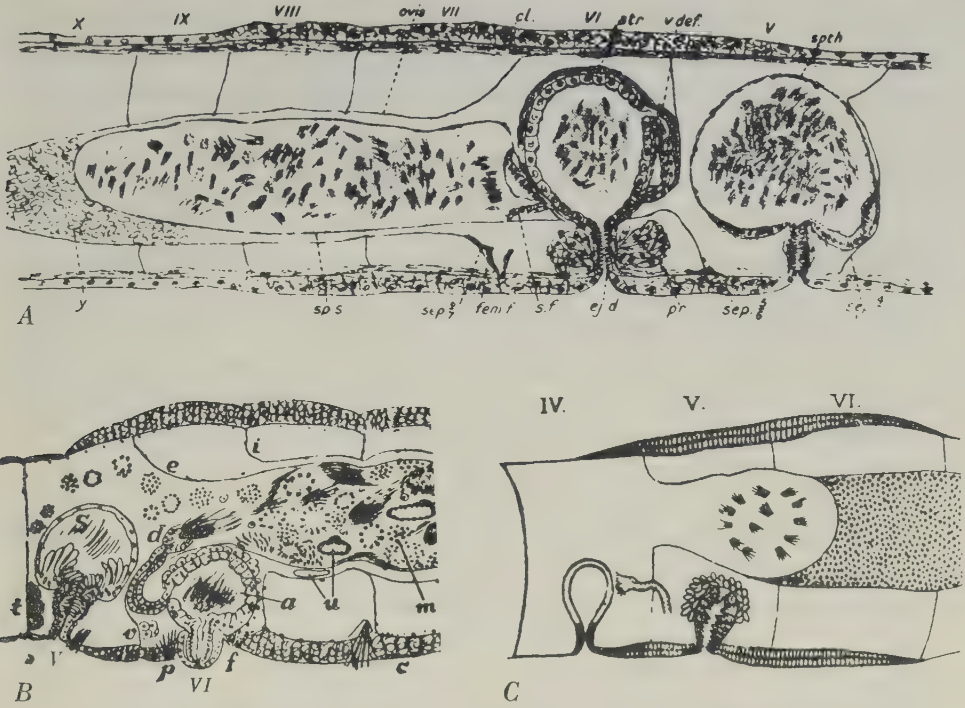

Fig. 28. Genital organs. *A Branchiodrilus hortensis* (from MEHRA, 1920), *B Allonais paraguayensis* (from MARCUS, 1943), *C Stephensoniana trivandrana* (from AIYER, 1930). *A* about 125 ×.

plexuses in the body wall, and the dorsal vessel is situated ventrally, not dorsally as in *Homochaeta*.

On the other hand, *Haemonais* may possibly have some connection with *Dero*, where the sexual organs are fairly similar, with well-developed ducts and glandular atrial epithelium (Fig. 27 *A*). The dorsal vessel is ventral, and a state with commissural vessels in all segments behind V is found in *Allodero lutzi* and *Aulophorus superterrenus*; this and the presence of segmental vascular loops in the newly-formed segments of *D. digitata*, indicate that this state is probably primitive in *Dero*, too. *Branchiodrilus*, which also presents these resemblances to *Dero* (Fig. 28 *A*), and which has (one species, at least) ventral setae changing shape considerably farther back than at the transition between the segments formed anteriorly on budding, and the rest, like *Haemonais*, may have perhaps some connection with these two genera. The tendency in the three genera to develop special respiratory organs may also point in this direction.

Lastly the genus *Stephensoniana* seems to occupy a solitary position. 4 segments are formed anteriorly by budding, as in *Paranais*, but the dorsal setae begin in II, the needles being straight, simple-pointed, without a nodulus. There are no coelomocytes. The vasa deferentia probably join the gland-covered atria near the top (Fig. 28 *C*), and the penial setae have an unusual shape, with two blunt prongs. Everything indicates that this genus, too, is fairly independent; yet it is too little known to allow of any definite conclusions, so I have provisionally ranged it with the subfamily *Naidinae*, i. e. all the genera not included within the *Pristininae*, *Paranaidinae*, or *Chaetogastrinae*. Thus, the subfamily *Naidinae* according to this conception, is more limited than according to that of Lastočkin, who united in it all genera except *Pristina*.

The *Naidinae* might have been subdivided into sub-groups, *tribus*, the *Slavina-Stylaria* group forming one *tribus*, the *Nais* group another. However, the position of several genera is so uncertain that it has seemed better not to attempt such a subdivision yet.

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With the aid of this survey it may be possible to draw some conclusions as to the primitive characters of the family. Some may be regarded as reasonably certain, such as: a prostomium without proboscis; ventral setae all of one type (the state with differentiated setae being present only in fairly specialized species of a few genera); a pharynx with pharyngeal glands; oesophageal, but not septal, glands (cf. p. 20); probably a slowly widening stomachal dilatation (cf. p. 248); presence of coelomocytes; free, open nephridia.

Eyes were probably not present in the primitive condition. Such are found only in the *Nais* group and the *Stylaria-Slavina* group (incl. *Piguetiella*), and are absent in all other Oligochaeta. So presumably they have developed within the family, perhaps more than once.

The situation of the foremost dorsal setae presents another problem. The alternatives are: in II, as in nearly all other Oligochaeta; in the first segment behind the budding-zone, as in a great many *Naididae*; or somewhere between. The first alternative seems to be by far the most probable. If any of the others were true, setae which had been completely lost with their setal sacs and all, would have reappeared in a number of cases, which seems exceedingly unlikely. The assumption that the dorsal setae in a different number of segments have disappeared in various cases seems far more reasonable. (It can hardly be maintained that the ancestor of the whole order had dorsal setae beginning in any other segment than II, as in all other recent families, except the *Phreodrilidae*, as well as the Polychaeta.) Thus, the presence of dorsal setae from e. g. IV will, within reason, be a more primitive character than presence from V or VI onwards (cf. p. 248).

Another question concerns the composition of the dorsal setal bundles.

Were hair setae present, as in most genera, or did the dorsal bundles consist of needle setae only? The latter condition prevails in e. g. the *Chaetogastrinae* (except *Chaetogaster*, where they are absent), and the *Paranaidinae*, which were above considered as very old; this may argue in favour of the primitiveness of this character. On the other hand these subfamilies are very deviating, and certainly not ancestral to the others, and in the *Pristininae* hair setae are always present, as in the overwhelming majority of the cases in the *Naidinae*. It seems most probable that hair setae were present in the primitive condition, getting lost independently in a number of cases, so much the more so, as hair setae are present in the Polychaeta, and thus must reasonably be assumed to have been present in forms ancestral to the Oligochaeta.

The needles may be assumed to have been either double-pronged crotchets, like the ventral ones, or similar to hair setae. The former concept is supported by the prevalence of crotchets in the *Tubificidae* and the "higher" Oligochaeta, the second by the predominance of hair-like setae in the *Aeolosomatidae*. If the latter were ancestors of the *Naididae*, as is maintained by some authors (cf. pp. 261, 265), the hair-like state of the setae ought apparently to be primitive in the *Naididae*, too.

Within the *Naididae*, crotchet-shaped needles are present in the *Chaetogastrinae*, the *Paranaidinae*, *Homochaeta*, *Uncinais*, and *Piguetiella*, and a very similar form is found in *Haemonais*. Thus, they are found in a large number of the groups. On the other hand, simple-pointed needles are found in some *Pristina*, *Stephensoniana*, *Branchiodrilus*, the *Slavina-Stylaria* group, and some *Nais*. In the latter the simple form is, however, without doubt derived from a double-pronged one (cf. p. 131); this fact no doubt supports the view that such is generally the case. Likewise in *Pristina* the simplest needles are found in species which cannot be considered as primitive (cf. p. 244). Generally the species with hair-like needles have also long hair setae, and are very agile forms (e. g. the *Pristina* with simple needles), often more able swimmers than their relatives with double-pronged needles (e. g. species of *Nais*, the *Stylaria* group), and in such cases the form may be regarded as a specialization. *Vejdovskyella* forms a remarkable exception, as it does not swim, and lives in fairly dense vegetation, where crotchets would seem to be a far more appropriate instrument for locomotion. The most reasonable explanation seems to be that *Vejdovskyella* is a descendant of a swimming form with hair-like needles, and that the stout, serrated hairs have taken over the task of crotchets. The hairs might also be inferred to act as defence weapons. As to *Branchiodrilus*, the dorsal setae are enclosed within the gills, which makes the simple form natural. Here, the needles are not quite hair-like, as in the *Stylaria* group and some *Pristina*, but have a fairly stout shaft, and a tapering distal end, according to YAMAGUCHI's Fig. 2 *B*. About *Stephensoniana*, too little is known to allow of any discussion of the matter.

As a whole, it seems fairly certain that crotchet-like needles are primitive in the family, having undergone different modifications in a number of cases.

Another, more difficult, problem is the initial state of the vascular system. This might be represented by the form with only one simple commissural loop in each of the segments formed anteriorly on budding. This form is found in *Piguetiella*, the *Stylaria* group (here a bifurcation may occur), and some *Pristina* (and *Allonais pectinata*; cf. p. 207), and complicated by a not too large number of anastomoses and bifurcations in *Ophidonais*, *Nais*, and *Vejdovskyella*. Further complications, and additional loops might then be a secondary result of greater body-size, which would necessitate more elaborate arrangements for the oxygen-supply. On the other hand, a state where vascular loops are present in the whole body may be primitive (the lesser numbers will then be a result of reduction), or even the state with a plexus anteriorly, and simple loops in the rest of the body. STEPHENSON (1930, p. 701), for instance, regards the simple systems of the *Aeolosomatidae* and most *Naididae* as reduced in connection with the smaller body-size and more permeable body-wall than that of the *Tubificidae*, which he regards as ancestral of these families. He does not express any opinion as to the course of development within the *Naididae*. If the most simple form were primitive within the family, additional loops in the whole body must have developed at least once (if *Haemonais* and *Branchiodrilus* are assumed to emerge from the same form as *Dero*), and smaller numbers in the *Paranaidinae* (cf. below), *Stephensoniana*, *Allonais*, and *Specaria*, and within *Pristina*. In *Dero* either reduction must have taken place once more, or a complete series has developed independently in *Aulophorus superterrenus*. The loops in the most anterior segments must have been complicated to form a plexus in the *Paranaidinae*, the *Dero* group, (cf. above) *Specaria*, *Homochaeta*, *Uncinais*, *Slavina*, and within *Pristina* (about *Stephensoniana* nothing is known of the topography of the vascular loops in I—IV). Reduction has taken place in the *Chaetogastrinae*.

If, on the other hand, the state with one loop in every segment is assumed to be primitive, which seems more reasonable with regard to the fact that this state is found in most Oligochaeta, only a series of reductions needs to be assumed with regard to the loops behind those of the segments formed at the anterior end on asexual reproduction. A complete reduction, then, has taken place in the *Chaetogastrinae* (here also further reduction), the *Pristininae*, the *Nais* group (except *Specaria*), the *Slavina*-*Stylaria*-*Piguetiella* group, *Homochaeta*, and *Stephensoniana*, and a partial reduction in the *Paranaidinae*, *Dero*, *Allonais*, and *Specaria*. In *Haemonais* and *Branchiodrilus* extra complications have developed. Another fact pointing towards the primitiveness of the complete series of loops is the formation in the budding hind segments of species of *Paranais* and *Dero* of segmental vascular loops, which disappear later (cf. pp. 40, 41). These loops in *Paranais* are in fact not connected with the septa, as in *Dero* and *Haemonais* (*Branchiodrilus*?), but this may be a secondary phenomenon.

The question still remains to be answered, whether the vascular commissures in the preovarial segments, too, consisted of simple loops, undergoing different degrees of complication in a number of cases, or constituted a plexus, as in many of the genera, and in most *Tubificidae* and "higher" Oligochaeta.

The former conception seems to be the most natural and probable one. If a plexus had been present initially and undergone simplification in a number of cases, it would be a very odd coincidence that the end stage of the process would always result in one pair of vessels per segment, never more or different numbers in different segments, and that in cases of less far advanced simplification one loop in each segment would already be always discernible.

The causes for the process of complication seem obscure. Large body-size may be one, but it cannot be alone responsible, since such a large form as *Ophidonais* has a fairly simple system, and fairly large ones as *Piguetiella*, *Stylaria*, and *Arcteonais* have a very simple one, and on the other hand, the minute *Pristina amphibiotica* and the small-sized species of *Paranais* have a plexus.

As to the sexual organs, the vasa deferentia perhaps most probably entered the atria on top, as in *Chaetogaster*, the *Pristininae*, *Homochaeta*, probably *Stephensoniana*, and several other *Naidinae* (and the *Tubificidae*). For the original distribution of the prostate glands, several possibilities are open: either the prostate was concentrated on the vasa deferentia, whereas the atria had a non-glandular epithelium and no prostate, as in the *Nais* group; or the vasa deferentia had no prostate, but the atria had a glandular epithelium and prostate, as in the *Slavina-Stylaria* group and *Piguetiella*; or there was no prostate at all, but the atrial epithelium was glandular, e. g. in *Dero*, *Haemonais*, and *Branchiodrilus*; or both atria and vasa deferentia were glandular and provided with prostate, which state is not known in the family (about *Stylaria lacustris* cf. p. 51); or no prostate at all was present, nor was the epithelium of either the vasa deferentia or the atria glandular. The last case seems to be by far the most probable, as in the other cases strongly glandular epithelia must have become non-glandular again, and in most cases prostates must have been dropped, and even developed again in a new place (cf. p. 252).

Another difficult question is that of the original place of the sexual organs, which is connected with the number of segments formed at the anterior end on asexual reproduction. Did they lie in V—VI, as in most genera, or perhaps in VII—VIII, as in *Pristina*, the more forward positions being the results of a series of "jumps", as argued by STEPHENSON? The latter considered the *Naididae* as descended from the *Tubificidae*, where the sexual organs normally lie in X—XI, but in a few genera, especially *Aulodrilus*, are situated in more anterior segments; this would be the result of a shifting forwards. He regards the position in the *Naididae* as obtained in the same manner. The assumption that the *Chaetogastrinae* and the bulk of the *Naidinae* would have passed through a stage with the sexual organs 2 segments further back, and the *Paranaidinae* and *Stephensoniana* yet another stage before reaching their present position does not appear very attractive. It seems more reasonable to suppose that when the family was in its earliest stages the position of the sexual organs (and thus the number of budded segments) was not yet determined, but variable; later the position became fixed, once giving the result (for the testis segment) of VII, in the *Pristininae*, twice V, in the *Chaetogastrinae* and the *Naidinae*, and twice IV, in the *Paranaidinae* and *Stephensoniana*. Of course more possibilities may have been realized initially, only those mentioned having survived.

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After these considerations an attempt may be made to trace the phylogenetic order of the subfamilies and genera of the *Naididae*. As was argued above (p. 246) the *Chaetogastrinae* are so profoundly dissimilar to the rest of the family that they may be assumed to have taken their own course very early, probably before any of the other groups had differentiated. Then the *Paranaidinae*, the *Pristininae*, and probably *Stephensoniana* will have branched off from the bulk of the family, the *Naidinae*, though in which order this occurred is impossible to judge.

Among the *Naidinae* it seems probable that *Homochaeta* formed an early branch of its own, having such presumably primitive characters as dorsal setae beginning in II, the needles being wholly similar to the ventral setae (the hairs have disappeared), the vasa deferentia opening on top of the atria, both being devoid of prostate, and penial setae shaped like ordinary setae.

Among the rest, the *Nais* group (*Nais*, *Ophidonais*, *Uncinais*, and *Specaria*) form one branch, *Specaria* being a little remote from the rest. Of these perhaps *Nais* and *Ophidonais* are most closely related to each other, both having relatively simple vascular loops, though it is difficult to judge.

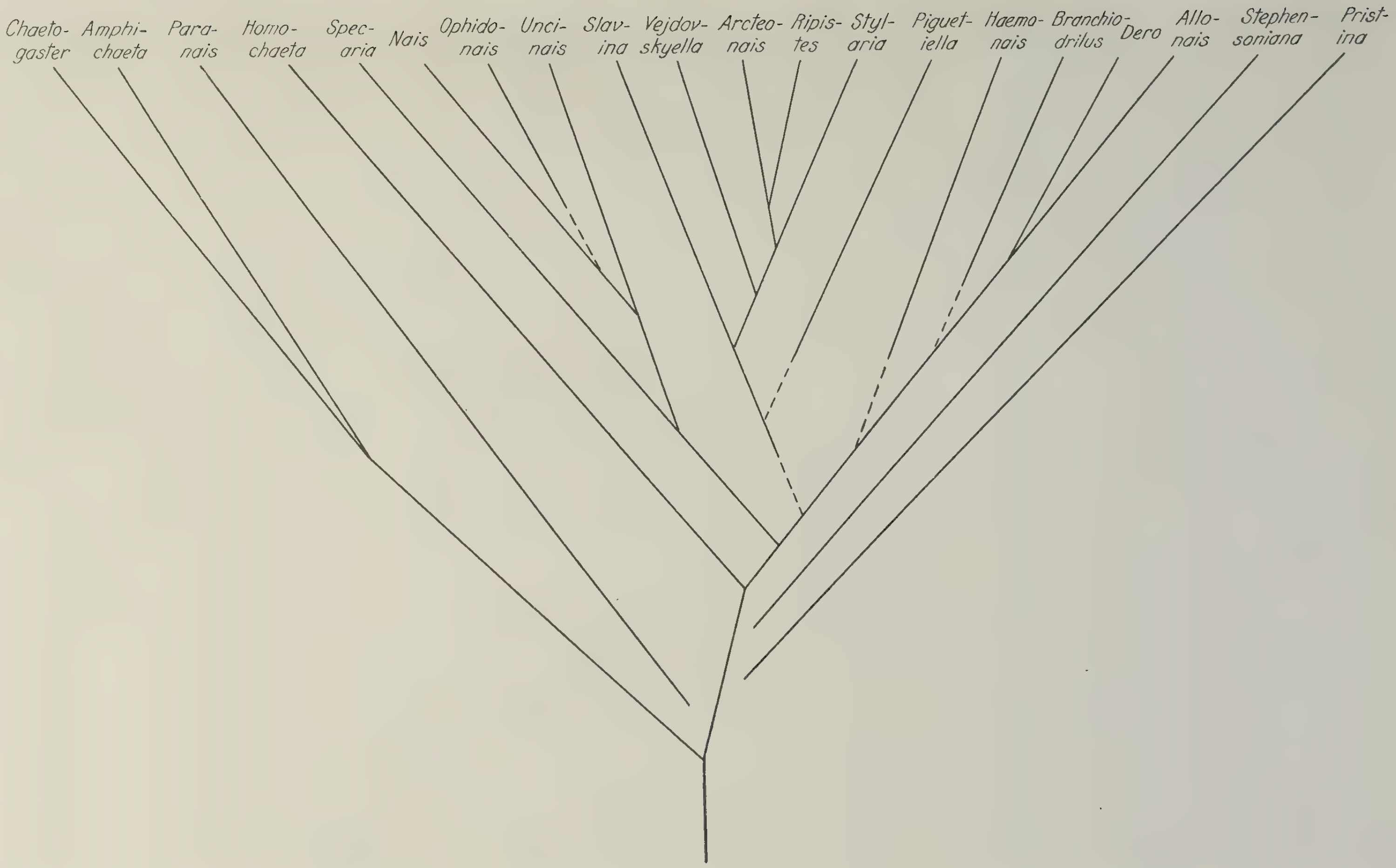
Chaeto-gaster
Amphi-chaeta
Para-nais
Homo-chaeta
Spec-aria
Nais
Ophido-nais
Unci-nais
Slav-ina
Vejdov-skyella
Arcteo-nais
Ripis-tes
Styl-aria
Piguet-iella
Haemo-nais
Branchio-drilus
Dero
Allo-nais
Stephen-soniana
Prist-ina

Fig. 29.

The *Slavina-Stylaria* group (*Slavina, Vejdovskyella, Arcteonais, Ripistes,* and *Stylaria*) forms another branch, *Piguetiella* probably constituting an early side-branch (cf. p. 252). *Slavina* probably branched off next, as it contains species with dorsal setae already beginning in IV, and species in which the needles are still bifid. Also, the stomachal dilatation is slow. The commissural vessels are plexiform, whereas in the rest of the species of the group they are more or less simple. In these the needle setae are always hair-like. *Vejdovskyella,* with the slow stomachal dilatation and dorsal setae beginning in V in one species, will then form one branch, the remaining closely related genera, another. Of these genera *Arcteonais* and *Ripistes* seem to stand most closely together, for their sexual organs are of the same type, and both have a large number of setae in at least some of the dorsal bundles.

Of the remaining genera, *Dero* and *Allonais,* as argued above (p. 252), will probably have a common origin, and *Haemonais* and *Branchiodrilus* may provisionally be ranged together with them. Of these *Haemonais* may then be supposed to form the earliest branch, containing a form with hair setae beginning in II.

The order in which the three large trunks — the *Nais* branch, the *Piguetiella-Stylaria* branch, and the *Dero* branch — emanate from the common stem is hard to judge. One fact speaks for the closer affinity between the two first-mentioned groups, namely the presence of eyes in both these groups, and in these only. On the other hand the distribution of the prostate argues against this (cf. p. 257). The conditions of the prostate in the *Stylaria* group may, however, be derived from those in the *Dero* group, where no prostate is present, but the atria have a glandular epithelium. In this case, eyes will probably have developed independently in the *Nais* group (perhaps after the formation of *Specaria*) and the *Stylaria* group, for eyes can hardly be supposed to have been present in any form ancestral to the *Dero* group, as eyes are never met with here. Thus, it must be considered which may more probably have developed twice, eyes, or a glandular epithelium, a case, which it is hardly possible to decide.

The scheme, p. 259, illustrates the phylogeny of the genera according to the above conception. The scheme will necessarily be uncertain in many respects, but is intended as a first step towards a more truly phylogenetical view of the *Naididae.*

Relations to other Oligochaeta.

Some consideration may also be given to the relations of the *Naididae* to the other Oligochaeta. MICHAELSEN in his later works (e. g.

1928, 1929) regarded the *Naididae* (and *Enchytraeidae*) as descended from the *Aelosomatidae*, and the *Tubificidae-Phreodrilidae-Lumbriculidae*, and through the latter, all other Oligochaeta (and the Hirudinea), from the *Naididae*, giving a continuous ascent from the simplest types to the most complex. STEPHENSON (1930, p. 703) comes to a partly opposite conclusion: *Lumbriculidae-Phreodrilidae-Tubificidae-Naididae-Aeolosomatidae* as a result of continued reduction. The *Lumbriculidae* he regards, following MICHAELSEN, as ancestral of all other Oligochaeta, too, and the Hirudinea.

MEYER (1926, 1929 a, b, c) goes the whole way and derives the *Lumbriculidae-Tubificidae* (including the *Phreodrilidae*)-*Naididae-Aeolosomatidae* from the *Phreoryctidae* (*Haplotaxidae*), and these either from the Archiannelida, or rather through the *Megascolecina* and *Lumbriculina* from the Polychaeta, preferrably the *Eunicidae* (1929 b). He does so chiefly on the following reasons:

1) The "substitution theory." MEYER (1926) derives the metanephridia from primary gonostomes which would have joined the protonephridia originally functioning as excretory organs, giving a nephromixium, as in species of *Tomopteris*. By and by the gonostome would have taken over the function of conveying the excretory fluid, too, and the solenocyte part would have disappeared, as in other species of *Tomopteris*. Then the metanephridia would have lost the task of conveying the sexual products, secondary gonostomes being formed for this purpose. Thus, both male and female efferent apparatus in the Oligochaeta would be secondary coelomatic formations, having no relation to the nephridia or the primary gonoducts (cf. BENHAM, 1904, who suggested that a coelomostome had been grafted on to the metanephridium, later the two separating). Now MEYER homologizes the marginal cells of the nephrostomes in the terricoles and the *Lumbriculidae* with the nephrostome (= primary gonostome) in the *Tomopteridae* and some other Polychaeta, while in the families without marginal cells, the original funnel would have wholly disappeared, no "truly epithelial" component being left. The *Lumbricina*, *Megascolecina*, and *Phreoryctina* (according to the system of MICHAELSEN, 1928), where the marginal cells are numerous, would be more primitive, the *Lumbriculina* with a lesser number less so, and the *Tubificidae*, *Naididae*, and *Aeolosomatidae*, without marginal cells, would be the most recently formed families.

This "substitution theory" has been severely but justly criticized by GOODRICH (1946, pp. 203—205), and even if the marginal cells were actually homologous to the Polychaete funnels, and the families with marginal cells in this respect more primitive than those without, this alone can on no account justify the derivation of the "limicoles" from the "terricoles."

2) The "Stauchungshypothese." MEYER is of the opinion that the gonad segments in all Oligochaeta are homologous, gonads not being able

to wander from one segment to another; also no shifting backwards through division of segments can have taken place, such a process being bound to get revealed through the ontogeny, as the coeloms are teloblastically formed from one single cell each. The only possible means of shifting gonads according to him is "Stauchung," i. e. the disappearance of whole segments, or the mesodermal or ectodermal component of one or more segments. Therefore those families are most primitive, the gonads of which have the hindmost position, i. e. the ovaries in XII, or XII and XIII and the testes in one or more segments in front of these. Thus, the "terricoles" and the *Lumbriculidae* would be most primitive, then the *Tubificidae*, the most strongly modified being the *Naididae* (and *Aeolosomatidae*).

The conditions in e. g. *Lumbriculus variegatus*, pointed out by MICHAELSEN (1929), where shifting and multiplication of gonads must have occurred frequently, MEYER dismisses as the result of a "phenomenon which causes a caenogenetical distribution over several segments of characters originally restricted to one or a few segments" (transl.), probably being connected with a condensation in the ontogenesis, which he often refers to (cf. below).

It remains to be explained how the position of the gonads in the *Opisthocystidae* was brought about according to this hypothesis. Here the testes lie in XXI, and the ovaries in XXII, which was not known at the time.

According to this hypothesis MEYER explains among other things (1929 a) the long vasa deferentia of the *Lumbricidae*, stretching over several segments, through disappearance of a corresponding number of hermaphrodite coeloms, which would have had the male funnels of each segment successively opening into the common vas deferens of their side. The funnels would have disappeared with the coeloms, but the ducts (in spite of their mesodermal origin!) would have persisted, and the ovarial coeloms of the following segments would have migrated into the remaining ectodermal envelopes. It seems impossible to explain how such a procedure could possibly escape attention during the ontogenesis, especially so, as apparently all posterior coeloms must have followed the advancing ovarial coeloms.

MEYER points out a number of characters in which the "meganephrostomatous" (MICHAELSEN, 1929) families would be more primitive than the rest. Among these are the absence of hair setae in the former. He describes a "lumbriculid" stage in the development of *Tubifex tubifex*, with 2 crotchets per bundle dorsally, and no hair setae, which would appear later. This stage would be a recapitulation of the conditions in the *Lumbriculidae* and, indirectly, the *Phreoryctidae*. The hair setae in the *Tubificidae*, *Naididae*, and *Aeolosomatidae* would be a secondary adaptation to life in fresh water. However, PENNERS (1933) has shown that a stage with 2 crotchets and no hair setae does not exist in *Tubifex tubifex*, where the first crotchet is always followed by a hair seta, and so on, a hair seta always accompanying each crotchet. He supposes that MEYER has had some species without hair setae before him, where such would quite naturally not be found during the ontogenesis either. Anyhow, M.'s statement can have no general validity. — Several other reasons seem to have been successfully refuted by MICHAELSEN (1929). Others, such as the extension of the region of the gonads over several segments, may be valid, but do not necessitate the supposition of the bearers of these characters as ancestral to the others.

MEYER frequently refers to "the principle of precocious differentiation and developmental concentration" (cf. above) which would have seized the Clitellata. Thus he explains the continued formation of segments at the posterior end in adult *Tubificidae* as a result of a surplus growth energy inherited from larger ancestors, which is still localized at the hind end, but may, according to this principle, mature at more and more early embryonic stages, and thus get distributed over a greater number of segments, that is middle and anterior segments, and give rise to fission zones. The *Naididae* would represent the end stage of this process (1929 a, p. 543). In a later paper (1929 c, p. 12) he makes this principle responsible also for the lateral line formed by the sarcoplasm portions of the circular muscle-fibres of the body wall, and for the tendency towards a constant number of cells in *Parergodrilus*, though he has some months before (1929 a, p. 523) explained these phenomena, and the budding, as a result of the remaining at a juvenile developmental stage inherited from higher developed ancestors! The appearance of eyes and gills, and the setal conditions in the *Naididae*, are to be understood in the same way by assuming that the Naids arose from juvenile Tubificids (and Lumbriculids), who emerged into the freer "Lebensraum" above the bottom!

MEYER has many other notions which cannot be related here, but on the whole it seems that his speculations about the internal phylogeny of the Oligochaeta are rather misleading.

One circumstance seems to have been recognized by all authors hitherto, namely that the *Tubificidae* are among the closest relatives of the *Naididae*. STEPHENSON points to the fact that the sexual organs are built on an identical plan in the two families, only in the *Tubificidae* they are often more highly developed, with penes, solid prostates, etc. (In the *Naididae* they lie further forwards than in most *Tubificidae*.) The setal equipment is the same, with the indefinite number of hair setae and crotchet-like needle setae in the dorsal bundles in the primitive stages in both families. Other systems also are very similar, and recently HRABĚ (1937 a) and MARCUS (1944, pp. 82—86) have shown that species of *Aulodrilus* (*A. pluriseta, pigueti*, and *limnobius*), and of *Bothrioneurum* (*B. vejdovskyanum* and *pyrrhum*, and probably *iris*) propagate regulary by architomy, like several *Naididae*. In the species of *Aulodrilus* mentioned, the testes lie in VI, the ovaries in VII, and 6 segments are regularly regenerated at the anterior end; in the species of *Bothrioneurum* the testes are situated in VIII, the ovaries in IX, and 8 segments are formed. Thus, the conditions are quite correspondent to those found in some *Naididae*. In my opinion, however, the idea of deriving either of the families directly from the other is not to be entertained. Certainly they have, however, a common root, but to try to make a detailed picture of this ancestor, e. g. the place of the sexual organs (cf. p. 258) would be rash. — The ontogeny, on the other hand, was no doubt of the regular type found in the *Tubificidae*, not of the aberrant one present in the *Naididae* with a periblast forming round the embryo (Svetlov, 1923, 1926 b; Dawydoff, 1940).

As to the *Aeolosomatidae*, they show a number of very primitive characters, which were, however, regarded by Stephenson (1930) as partly paedogenetic (the non-fused halves of the nervous system, connected with the epidermis, the incomplete separation of the dorsal vessel from the intestinal plexus, the persistence of ciliation on the lower surface of the prostomium). Marcus (1944, p. 48), however, like Michaelsen regards these characters as truly primitive and mentions a number of others, too: the ciliated pits on the prostomium, non-formation of sperm-sac and ovisac, similar setae in the dorsal and ventral bundles, and the facts discovered or established by him, of multiple production of germ-cells, absence of a special male efferent apparatus, the sperms being evacuated by the nephridia, and the occasional presence of a nephridium beginning in the peristomial segment (in *Ae. headleyi*). In my opinion he is quite right here, and I should like to stress the great dissimilarities between the *Aeolosomatidae* and all the rest of the Oligochaeta, also the *Naididae*. Thus, the presence of nephridia in nearly all segments distinguish them from the latter family, as well as the circumstance that only 2 segments are formed by budding at the anterior end (cf. Marcus, 1944). The sexual organs of two species, *Ae. headleyi* and *kashyapi*, have been thoroughly described by Marcus, and he seems to have established beyond doubt the fact stated or assumed by most earlier authors (e. g. Štolč, 1889; Ditlevsen, 1904) that the male products are conducted out by nephridia. (The statement by Dehorne, 1916, that an unpaired atrium is present must be assumed to be erroneous.) Vejdovsky (1905) who investigated the nephridia in *Ae. thermophilum* (immature!) denies the possibility of sperm passing through them, and believes the other authors to have been mistaken.

In *Ae. kashyapi* Marcus found a unilateral (right-sided) clitellum in V—VI, with an ovum developing between the setae of these two segments.

Under this egg an unpaired female pore was found. The male gonocytes develope in the splanchnopleure of VI and VII. The sperms are evacuated by the paired nephridia of VI, the (only) left-sided one of V, and right-sided one of IV. These conditions fairly closely resemble those found by STOLČ (1889) in *Ae. Ehrenbergii* (= *hemprichii*), where the clitellum was developed ventrally in V—VI, and an ovum was found in VI. The sperms were evacuated by the (secondarily, during maturity) unpaired, enlarged nephridium of VI, and those of V and VII. He does not mention anything about a female pore, as MARCUS thinks (1944, p. 47), only the median pore of the enlarged nephridium of VI. He describes, however, a pair of spermathecae in IV (not 3 unpaired ones in III—V, as interpreted by BEDDARD, 1895, nor 1—3 pairs as stated by STEPHENSON, 1930; these authors no doubt have mistaken the pictures of 2 different stages and an aberrant form of the "spermathecae" (op. cit., Pl. VII, figs. 5—7) as representing spermathecae in different segments, the text being in Czech). Similar shapes were noticed by MAGGI (1865) and D'UDEKEM (1861). They are, however, extremely small, roundish, and stated to have an outer opening but no duct, and may be almost anything, but most probably a couple (MAGGI saw 3) of large gland cells.

In *Ae. headleyi* MARCUS found a diffuse clitellum of scattered cells ventrally in IV—X, formation of female gonocytes in all segments from V onwards, and of male ones in all segments from III onwards, unpaired female pores in VI—IX, and sperm evacuation through the nephridia of all the segments III—XV. He emphasizes that the nephridia (which are occasionally double or multiplied in this species) are quite wide enough to allow sperm to pass. MARCUS regards this state, with formation of gonocytes in most segments as the most primitive, and I wholly agree with him. It points to the Polychaeta, or Polychaete-like forms, which are generally regarded as ancestors of the Oligochaeta. The only essential difference in the sexual organs is the clitellum of the *Aeolosomatidae*. (According to the theory of GOODRICH; cf. GOODRICH, 1946; the original state would have been one with nephridia, and special gonoducts; the state in *Aeolosoma* would then be secondary. However this may be, the *Aeolosomatidae* are still quite unlike the other Oligochaeta in this respect.)

Regarding this fact, and the others referred to above, especially the occurrence of hair-like, straight or curved setae, in some species accompanied by needle-like setae (not very reminiscent of other needles, and sometimes serrated) dorsally *and* ventrally (or needles only *ventrally*, in *Ae. evelinae* Marcus), it appears quite improbable that the *Aeolosomatidae* are either ancestors or descendants of any of the other Oligochaeta. (MARCUS, 1944, p. 49, seems to regard them as ancestral of all Oligochaeta.) I regard them as a trunk of their own, the connections of which with the main body of the Oligochaeta are quite obscure.

With the family *Opisthocystidae* (Černosvitov, 1936), with the species "*Pristina*" *flagellum* Leidy, the Naidid-Tubificid stem has much in common, but the differences are also important. Similarities are the existence, in the *Opisthocystidae*, of serrated hair setae and hair-like needles dorsally from II onwards, as in e. g. *Pristina longiseta*, of commissural vessels in all segments (in fact simple ones from IV onwards, those of I—III being faintly branching and anastomosing, not forming a plexus; thus conditions which are not found together in the *Naididae* or *Tubificidae*), a ventrally situated dorsal vessel, budding of 5 segments at the anterior end, and the nephridia beginning in VII, as in most *Naididae.* Anal gills are present, as in *Dero*, but not as proliferations from a branchial "fossa," which forms a prolongation of the intestine, but as direct extensions from the body-wall, with a large coelom in them. The chief distinctions are those of the genital apparatus: the place of the testes in XXI, the ovaries in XXII, the spermathecae behind these in XXIII; the atria have an investment of enormous prostate gland cells, and have a true, eversible penis, a character not found in the *Naididae*, though structures reminiscent of it occur in the *Tubificidae.* Also the sperm- and egg-sacs seem to be paired. It seems certain, that *Opisthocysta* cannot be derived from the *Naididae*, as this would imply both the shifting backwards of the sexual organs through a very great number of segments, the inversion of the order between these, the formation of a new organ, the penis, and other changes not mentioned. It may, however, be derived from the same root as the Naid-Tubificid branch.

Černosvitov (op. cit., pp. 83—84) also compares *Opisthocysta* with the *Phreodrilidae*, especially *Hesperodrilus*, where the spermathecae also lie behind the gonads, and a penis is present. In this family, however, the dorsal setae, more or less hair-like setae only, begin in III, and the ventral setae are always two per bundle. There are commissural vessels in II—VII only, (but the nephridia begin in VII). The prostate is a tubular structure, and no atria are developed. The gonads lie in XI—XII, the spermathecal apertures in XIII. Budding or fragmentation are not found. Some connection with the *Opisthocystidae* does not seem excluded, but it is certainly remote, and so are connections with other families. On no account can the *Phreodrilidae* be ancestors of the *Tubificidae* and *Naididae.*

As to the *Lumbriculidae*, it is hard to explain how Stephenson arrived at the conclusion that they are ancestral of the *Tubificidae.* They have the lumbricine arrangement of setae (2 usually simple-pointed crotchets per bundle), which is undoubtedly secondary, and Stephenson himself (1930, p. 693) points out that the presence of hair setae in the *Naididae* and *Tubificidae* is no doubt an inheritance from the Polychaete-like ancestor of the Oligochaeta. Thus, they cannot have passed through a stage without hair setae. Neither is it probable that the number of setae per bundle has ever been fixed. Also, the spermathecae in the *Lumbriculidae* are often situated behind the gonads (and were probably so originally; cf. STEPHENSON 1930, p. 783), and both gonads and spermathecae are often present in more than one pair. This last character may well be more primitive than the state with only one pair of each, and possibly also the fact that the male ducts open in the same segment as the corresponding funnels, as was argued by STEPHENSON (op. cit., p. 706). It seems, however, impossible to go farther than to state that the *Lumbriculidae* and the Naid-Tubificid stem no doubt originate from a common, very primitive Oligochaete ancestor.

As to the terrestrial Oligochaeta, they, as stressed by STEPHENSON (op. cit., p. 693), very early took another developmental course than the "*Microdrili*," and can on no account be supposed to be ancestral of them.

Summary.

In order to achieve a conception of the taxonomy and phylogenetical relationships of the *Naididae*, comparative morphological studies have been carried out on 37 Swedish species, and the facts available in the literature on the family have been extracted.

Observations have been made on living material, and from preserved specimens, mounted whole or sectioned. The following organs have been chosen for more thorough examination, being most useful for taxonomical purposes in the family: the setae, the alimentary canal, the vascular system, and the sexual organs. Summaries of the appearance of these organs in the different genera and species are given in the general section. Here the general histology of the alimentary canal and the genital organs are also described.

The gland cells on the pharynx and oesophagus usually consist of two sorts, here called pharyngeal and oesophageal gland cells, the former occurring on the pharyngeal diverticulum, the latter mainly behind this, on the oesophagus; instead of this type, septal glands may be present, which are probably derived from the oesophageal gland cells. The pharyngeal gland cells are connected with the pharyngeal lumen, into which their secretion, staining like mucus, is poured.

A stomach has been found in all the species examined; the epithelium is usually invested with a brush border and cilia (special features are

found in the *Chaetogastrinae*, the *Pristininae*, and *Paranais litoralis*). Probably all Naids have a stomach, though not necessarily marked off by a dilatation. The intestinal epithelium is also invested with a brush border and cilia.

The dorsal vessel runs ventrally, to the left of the intestine, in *Specaria* and *Piguetiella*, besides the cases reported in the literature. It is decidedly left-sided, though not ventral, in a number of cases. In *Specaria josinae* there are not commissural vessels in all segments, as stated in the literature. Commissural vessels in newly-budded posterior segments were reported by BOURNE (1890) in *Paranais litoralis*; such are also found in *P. botniensis* and *Dero digitata*.

The clitellum consists of a layer of tall glandular cells, each of which contains, in the mature condition, one large vacuole filled with secretion globules staining like the cocoon-wall, a basal nucleus, and very little cytoplasm; between these are extremely narrow "supporting" cells with distal nuclei. The clitellum is often absent or has a different appearance, round and between the male pores.

Definite gonads are found in *Chaetogaster* as well as in other Naids. The atrial epithelium in *Stylaria* (and other genera with atrial prostate) is glandular; it does not lose its cell-borders and disintegrate, contrary to the statements by MEHRA (1920).

In the special section, the diagnostic features of each systematic unit have been shortly summarized. The synonymy of each species has been discussed, where it has not been wholly clear. For personally investigated species, descriptions are given of details of taxonomical interest, which were not, or only unsatisfactorily, described earlier, and measurements of setae and sexual organs (when met with) are given.

Three new species are described: *Paranais botniensis*, *Nais alpina*, and *Pristina idrensis*.

The genus *Paranais* is divided into three: *Paranais* (with dorsal setae from V on, septal glands, no nephridia, only 4 segments formed anteriorly on budding, and genital organs situated in IV—V, no prostate being present, vasa deferentia entering the atria distally, and clitellum being present round the male pores), *Homochaeta* (with dorsal setae beginning in II, no prostate, but vasa deferentia opening into the proximal end of the atria, and atria and spermathecae without ducts, the former opening into an invagination), and *Uncinais* (with dorsal setae from VI, eyes, and prostate on the vasa deferentia, which open distally).

The genus *Nais* has been divided into two: *Nais* and *Allonais* (the latter comprising species without eyes, stomachal dilatation and prostate, usually with an anterior vascular plexus and additional loops, propagating asexually by architomy).

The genus *Dero* has been divided into two subgenera: *Dero* and *Allodero* (with the species *A. malayana*, *bauchiensis*, and *lutzi*), *Aulophorus* being added as a third subgenus.

The phylogenetical interrelations between the genera of the family have been discussed, as well as the relations to some other Oligochaete families.

The genera *Chaetogaster* and *Amphichaeta* are closely related to each other, together forming an independent branch of the family; they have been separated as the subfamily *Chaetogastrinae.* Likewise the peculiarities of *Paranais* and *Pristina* respectively, indicate that these genera have branched off early from the common stem (cf. the scheme, p. 260). They have been separated as the subfamilies *Paranaidinae* and *Pristininae* from the rest, the *Naidinae.* Very probably *Stephensoniana* ought also to form a subfamily, but owing to the present imperfect knowledge of the genus, a separation has not been undertaken.

The *Tubificidae* are no doubt the closest relatives of the *Naididae*, but neither of these families can be derived from the other. The *Aeolosomatidae* are apparently very primitive in many respects, and not closely related to the *Naididae* or any of the other Oligochaete families.

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List of localities.

(For each locality the parish and province are, as a rule, given. I. = Idre, n. Dalecarlia; L. = Lövånger, Västerbotten.)

Anjan, lake in Kall, w. Jämtland. *Avasundet*, bay of the gulf of Bothnia, L. *Bjurön*, peninsula, L. *Bondkroken*, small lake near Mariefred. *Brunnsviken*, small lake in Stockholm. *Båven*, lake in Södermanland. *Bönan* near Gävle, Gästrikland. *Börstil* near Östhammar, n. e. Uppland. *Dalälven* at Leksand, Dalecarlia. *Degerträsket*, small lake in L. *Ekoln*, arm of Lake Mälaren, Uppland. *Foskan*, affluent to the river Storån, I. *Foskros*, I. *Fyrisån* at Uppsala. *Gersjön*, small lake in Fors, s. e. Jämtland. *Grövelsjön*, small lake in I. *Gällnarfjärden*, bay of the Baltic e. of N. Ljusterö in the "Skärgård" off Stockholm. *Hotagen*, lake in Hotagen, n. Jämtland. *Hågaån*, stream at Uppsala. *Hårsfjärden*, bay of the Baltic, Södermanland. *Häggsjön*, lake in Hotagen, n. Jämtland. *Hällsjön*, small lake in I. *Juvuln*, lake in Kall, Jämtland. *Karlsborg*, e. Västergötland. *Klintsundet*, strait at N. Ljusterö, the "Skärgård" off Stockholm. *Kräkångersfjärden*, bay of the Gulf of Bothnia, L. *Kräkångersselet*, small lake in L. *Kyrksjön*, small lake in L. *Kälarne*, Håsjö, s. e. Jämtland. *Landösjön*, lake in Offerdal, Jämtland. *Lilla Gladaviken*, small lake in L. *Limsjön*, small lake in Leksand, Dalecarlia. *Långsjön*, small lake in Rimbo, Uppland. *Lövsjön*, lake in Föllinge, Jämtland. *Mariefred*, Södermanland. *Metsjön*, small lake in Rimbo, Uppland. *Missjön*, small lake in L. *Opplimen*, small lake in Leksand, Dalecarlia. *Rengen*, lake in Hotagen, n. Jämtland. *Rudtjärn*, tarn in L. *Ryggmossen*, moor in Bälinge, Uppland. *Röjdåfjärden*, small lake in Östmark, n. Värmland. *Sandvikssjön*, lake in Föllinge, Jämtland. *Siljan*, lake in Dalecarlia. *Skedviken*, small lake in Rimbo, Uppland. *Slugusjön*, small lake in I. *Stora Gladaviken*, bay of the Gulf of Bothnia, L. *Storån*, source stream of the river Dalälven, I. *Styrsjön*, small lake in Leksand, Dalecarlia. *Sävsundet*, strait in the "Skärgård" off Bälinge, Södermanland. *Södertälje*, Södermanland. *Trehörningen*, small lake in Funbo, Uppland. *Ullevifjärden*, bay of lake Mälaren, Uppland. *Utö*, island in the "Skärgård" off Södermanland. *Valloxen*, small lake in Knivsta, Uppland. *Vallsträsket*, small lake in L. *Vettersö*, islet in Vettersöfjärden. *Vettersöfjärden*, strait at Ljusterö in the "Skärgård" off Stockholm. *Vettersö-Växlet*, islet in Vettersöfjärden. *Viggsjön* small lake in Nyskoga, n. Värmland. Lake *Vättern*. *Yttre Hågåsjön*, small lake in I. *Yttre Sörvattnet*, small lake in Linsäll, s. w. Härjedalen. *Åkerö tjärn*, tarn in Leksand, Dalecarlia. *Älgträsket*, small lake in L. *Öjaren*, lake in Högbo, s. Gästrikland. *Övre Hågåsjön*, small lake in I.

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Legends.

at	atrial ampulla
bb	brush border
bc	basophil cell
bf	branchial fossa
bbf	border of branchial fossa
c	cilia
cb	cell border
cc	coelomocytes
ced	common opening of ejaculatory ducts
ch	chloragogen
cl	clitellum
co	round drop or concrement
cp	cytophore
dinc	dark intestinal cell
dr	drop, stained
drl	layer of stained drops
dt	distal tooth of seta
dv	dorsal vessel
ec	epithelial cell
ed	ejaculatory duct
ff	female funnel
gl	gland cell
grl	granular layer
hs	hair seta
ic	intra-cellular canal
in	intestine
inc	intestinal cell
lmf	lower lip of male funnel
mc	mouth cavity
mf	male funnel
ml	muscular layer
n	nucleus
nec	nucleus of epithelial cell
neoe	neck of oesophageal gland cell
neph	neck of pharyngeal gland cell
nepr	neck of prostate gland cell
ngl	nucleus of glandular cell
ninc	narrow intestinal cell
noe	nucleus of oesophageal gland cell
npd	nephridial duct
nph	nucleus of pharyngeal gland cell
npr	nucleus of prostate gland cell
ns	needle seta
nsc	nucleus of "supporting" cell
oc	oocyte
oe	oesophagus
oec	oesophageal gland cell
og	oogonium
ov	ovary
p	atrial pocket
pc	cell projecting into stomachal lumen
pe	peritoneum
ph	pharynx
phc	pharyngeal gland cell
phd	pharyngeal diverticle
pm	muscle connecting atrial pocket with dorsal body wall
pr	prostate gland cell
ps	penial seta
pt	proximal tooth of seta
s	septum
sgl	septal gland
sgc	septal gland cell
sp	sperm
spa	spermathecal ampulla

spc	spermiocyte
spd	spermathecal duct
spg	spermiogonium
spp	pocket of spermathecal seta
spph	spermatophore
sps	spermathecal seta
ss	sperm sac
ssp	setal sac of penial seta
st	stomach
str	striation
stw	stomachal wall
t	testis
to	"Teilovarium"
u	"Urkeimzelle"
umf	upper lip of male funnel
v	blood vessel
va	vacuole
vach	vacuole with chloragosome-like contents
vd	vas deferens
vdo	opening of vas deferens into atrium
vn	ventral nerve cord
vv	ventral vessel
1, *2*, *3*, *4*	first, second, third, fourth pair of gills

Explanation of plates.

Pl. I.

Fig. 1. *Chaetogaster diastrophus*. Living. 30 ×.

Fig. 2. *Ch. langi*. Living. 30 ×.

Fig. 3. *Ch. cristallinus*. Living. 20 ×.

Fig. 4. *Ch. limnaei*. Living. 20 ×.

Fig. 5. *Ch. diaphanus*, sexually mature specimen. Sagittal section through the intestinal wall. Flemming, safranine-gentian violet-orange G. 360 ×.

Fig. 6. *Ch. diaphanus*. Atrium. Flemming, iron haematoxylin. 360 ×.

Fig. 7. *Ch. cristallinus*. Sagittal section through the genital region and the stomachal wall. Flemming, iron haematoxylin. 360 ×.

Fig. 8. *Ch. cristallinus*. Male funnel and spermatheca. Flemming, iron haematoxylin. 360 ×.

Pl. II.

Figs. 1—2. *Ch. cristallinus*. Transverse sections through the genital region. Flemming, safranine-gentian violet-orange G. 360 ×.

Fig. 3. *Ch. cristallinus*. Stomachal wall with cells projecting into the lumen. Flemming, iron haematoxylin. 560 ×.

Fig. 4. *Amphichaeta sannio*. Oblique section through the genital region with gonads. Ehrlich's haematoxylin-eosin. 220 ×.

Fig. 5. *A. sannio*. Horizontal section through the genital region with spermathecae and male efferent apparatus. Ehrlich's haematoxylin. 360 ×.

Pl. III.

Fig. 1. *Paranais litoralis*. Stomachal wall with intra-cellular canals, transverse section. Formalin, Ehrlich's haematoxylin-eosin. 720 ×.

Fig. 2. *P. botniensis*. Stomachal wall, longitudinal section. Alcohol, Ehrlich's haematoxylin-eosin. 720 ×.

Fig. 3. *P. botniensis*. Transverse section through the spermathecae. Flemming, iron haematoxylin. 560 ×.

Fig. 4. *P. botniensis*. Transverse section through the genital region, showing excessive formation of blood-vessels. Flemming, iron haematoxylin. 560 .

Fig. 5. *P. botniensis*. Transverse section through the male funnels. Flemming, iron haematoxylin. 560 ×.

Fig. 6. *P. botniensis*. Transverse section through the atria and ejaculatory ducts. Flemming, iron haematoxylin. 360 ×.

Fig. 7. *P. botniensis*. Sagittal section showing a penial seta. Flemming, iron haematoxylin. 720 ×.

Pl. IV.

Specaria josinae.

Fig. 1. Spermatheca, transverse section. Flemming, iron haematoxylin. 360 ×.

Fig. 2. Male funnels, transverse section. Flemming, iron haematoxylin. 560 ×.

Fig. 3. Vasa deferentia, transverse section. Flemming, iron haematoxylin. 560 ×.

Fig. 4. Atrium and atrial pocket, longitudinal section. Sublimate, Ehrlich's haematoxylin-eosin. 560 ×.

Fig. 5. Atrium and atrial pocket, horizontal section. Flemming, iron haematoxylin. 360 ×.

Fig. 6. Female funnel, transverse section. Flemming, iron haematoxylin. 560 ×.

Pl. V.

Fig. 1. *Specaria josinae.* Nephridium, packed against the ventral vessel, longitudinal section. Alcohol, Ehrlich's haematoxylin-eosin. 560 ×.

Fig. 2. *Uncinais uncinata.* Atrium, longitudinal section. Flemming, iron haematoxylin. 360 ×.

Fig. 3. *U. uncinata.* Female funnel, transverse section. Flemming, iron haematoxylin. 560 ×.

Fig. 4. *U. uncinata.* Spermatheca, longitudinal section. Flemming, iron haematoxylin. 360 ×.

Fig. 5. *Ophidonais serpentina.* Transverse section through the pharynx. Formalin, iron haematoxylin-picrofuchsin. 560 ×.

Pl. VI.

Fig. 1. *Ophidonais serpentina.* Sagittal section through the pharynx. Formalin, iron haematoxylin-picrofuchsin. 360 ×.

Fig. 2. *Nais communis.* Living, slightly pressed under a cover-glass. 10 ×.

Fig. 3. *N. variabilis.* Form with long hair setae, living. 20 ×.

Pl. VII.

Fig. 1. *Nais communis.* Oesophageal gland cells, sagittal section. Zenker, muchaematein. 1200 ×.

Fig. 2. *N. variabilis,* longitudinal section through the stomach and oesophagus. Alcohol, Ehrlich's haematoxylin-eosin. 360 ×.

Fig. 3. *N. simplex.* Spermatheca, transverse section. Flemming, iron haematoxylin. 560 ×.

Fig. 4. *N. simplex.* Transverse section with vasa deferentia. Flemming, iron haematoxylin. 360 ×.

Fig. 5. *N. simplex.* Transverse section through the atria. Flemming, iron haematoxylin. 360 ×.

Fig. 6. *N. alpina.* Vas deferens and spermatheca, longitudinal section. Flemming, iron haematoxylin. 360 ×.

Fig. 7. *N. alpina.* Male funnel, longitudinal section. Flemming, iron haematoxylin. 360 ×.

Pl. VIII.

Fig. 1. *Nais alpina.* Atrium and ejaculatory duct, longitudinal section. Flemming, iron haematoxylin. 360 ×.

Fig. 2. *N. alpina.* Atrium, longitudinal section. Flemming, iron haematoxylin. 360 ×.

Fig. 3. *N. alpina.* Longitudinal section with penial seta. Flemming, iron haematoxylin. 560 ×.

Fig. 4. *N. barbata.* Living. 20 ×.

Fig. 5. *N. pardalis.* Living, slightly pressed under a cover-glass. 20 ×.

Fig. 6. *N. pardalis.* Stomach, with projecting cells, longitudinal section. Alcohol, iron haematoxylin-picrofuchsin. 360 ×.

Pl. IX.

Fig. 1. *Nais elinguis.* Atrium and vas deferens, longitudinal section. Bouin, Ehrlich's haematoxylin-eosin. 360 ×.

Fig. 2. *N. elinguis.* Atrium with ejaculatory duct, transverse section. Bouin, Ehrlich's haematoxylin-eosin. 360 ×.

Fig. 3. *N. elinguis.* Transverse section through the spermathecae. Bouin, Ehrlich's haematoxylin-eosin. 360 ×.

Fig. 4. *Ripistes parasita.* Transverse section through the spermathecae. Flemming, iron haematoxylin. 360 ×.

Fig. 5. *R. parasita.* Atrium, vas deferens and male funnel, longitudinal section. Flemming, iron haematoxylin. 560 ×.

Fig. 6. *R. parasita.* Longitudinal section with penial seta. Flemming, iron haematoxylin. 800 ×.

Fig. 7. *R. parasita.* Atrium with duct, longitudinal section. Flemming, iron haematoxylin. 560 ×.

Pl. X.

Stylaria lacustris.

Fig. 1. Living, simple specimen. 20 ×.

Fig. 2. Transverse section through the pharynx with pharyngeal and oesophageal gland cells. Flemming, iron haematoxylin. 360 ×.

Fig. 3. Longitudinal section showing intestinal epithelium. Flemming, iron haematoxylin. 560 ×.

Pl. XI.

Siylaria lacustris.

Fig. 1. Clitellum, transverse section. Flemming, iron haematoxylin. 560 ×.

Fig. 2. Testis, transverse section. Flemming, iron haematoxylin-picrofuchsin. 560 ×.

Fig. 3. Longitudinal section through the genital region after oviposition. Flemming, iron haematoxylin. 220 ×.

Fig. 4. Prostate gland cells on atrium, transverse section. Flemming, iron haematoxylin. 560 ×.

Fig. 5. Living specimen (same as in Fig. 3) with transparent clitellum, showing the sexual organs. 10 ×.

Pl. XII.

Piguetiella blanci.

Fig. 1. Longitudinal section through the intestine of a mature specimen. Flemming, iron haematoxylin. 360 ×.

Fig. 2. Spermathecal setae. Potassium acetate preparation. 650 ×.

Fig. 3. Testis and a young spermatheca, transverse section. Flemming, iron haematoxylin. 560 ×.

Fig. 4. Ovary, transverse section. Flemming, iron haematoxylin. 560 ×.

Fig. 5. Transverse section with ventral part of clitellum in VI. Flemming, iron haematoxylin. 560 ×.

Pl. XIII.

Piguetiella blanci. Flemming, iron haematoxylin.

Fig. 1. Transverse section through the pockets of the spermathecal setae. 360 ×.

Fig. 2. Spermatheca, longitudinal section. 360 ×.

Fig. 3. Male funnel, transverse section. 560 × .

Fig. 4. Transverse section through vas deferens and spermathecae. 560 × .

Fig. 5. Transverse section through the atria at full sexual maturity. 360 × .

Pl. XIV.

Fig. 1. *Piguetiella blanci.* Sagittal section through atrium and vas deferens. Flemming, iron haematoxylin. 360 × .

Fig. 2. *Dero digitata.* Transverse section through the foremost part of the branchial region with the frontal ends of the first pair of gills. Flemming, iron haematoxylin. 300 × .

Fig. 3. *D. digitata.* Transverse section through the branchial region with the first and second pairs of gills. Flemming, iron haematoxylin. 300 × .

Fig. 4. *D. digitata.* Transverse section through the branchial region with the second pair of gills. Flemming, iron haematoxylin. 300 × .

Fig. 5. *D. digitata.* Transverse section through the posterior part of the branchial region with the third pair of gills, and the fusion of the second pair with the border of the fossa. Flemming, iron haematoxylin. 220 × .

Pl. XV.

Dero digitata.

Fig. 1. Transverse section through the pharynx with pharyngeal and septal glands. Bouin, muchaematein-magenta red. 360 × .

Fig. 2. Longitudinal section through the pharynx with pharyngeal gland cells. Formalin, iron haematoxylin-picrofuchsin. 560 × .

Pl. XVI.

Dero digitata. Formalin, iron haematoxylin-picrofuchsin. 560 × .

Fig. 1. Stomach, longitudinal section.

Fig. 2. Anterior part of intestine, longitudinal section.

Pl. XVII.

Dero digitata.

Fig. 1. Posterior part of intestine, longitudinal section. Formalin, iron haematoxylin-picrofuchsin. 560 × .

Fig. 2. Male funnel and ejaculatory duct at an early stage of maturity, longitudinal section. Bouin, Ehrlich's haematoxylin-eosin. 360 × .

Fig. 3. Male funnel and spermatheca of a fully mature specimen, longitudinal section. Flemming, safranine-gentian violet-orange G. 220 × .

Fig. 4. Atrium at an early stage of maturity, longitudinal section. Bouin, Ehrlich's haematoxylin-picrofuchsin. 360 × .

Fig. 5. Atrium of a fully mature specimen. Flemming, safranine-gentian violet-orange G. 220 × .

Pl. XVIII.

Fig. 1. *Dero digitata.* A ventral setal bundle from II. Potassium acetate preparation. 650 × .

Fig. 2. *D. digitata.* A posterior ventral setal bundle. Potassium acetate preparation. 650 × .

Fig. 3. *D. digitata.* Needle seta. Potassium acetate preparation. 650 × .

Fig. 4. *D. nivea.* Living, gills contracted. 20 × .

Fig. 5. *D. obtusa.* Living, posterior end with half-expanded gills. 70 × .

Fig. 6. *D. digitata.* Living, posterior ends with fully expanded gills. 30 × .

Pl. XIX.

Pristina amphibiotica.

Fig. 1. Living. 30 × .

Fig. 2. Stomach, stained *intra vitam* with neutral red. 360 × .

Fig. 3. Penial seta. Potassium acetate preparation. 1200 × .

Fig. 4. Longitudinal section through the genital region. Sublimate, Ehrlich's haematoxylin-eosin. 560 × .

Fig. 5. Male funnel and ejaculatory duct, longitudinal section. Sublimate, Ehrlich's haematoxylin-eosin. 1200 × .

Fig. 6. Testis and stomachal wall, longitudinal section. Sublimate, Ehrlich's haematoxylin-eosin. 1200 × .

Pl. XX.

Pristina idrensis.

Fig. 1. Living. 40 × .

Fig. 2. Testis, transverse section. Flemming, iron haematoxylin. 1200 × .

Fig. 3. Male funnel, transverse section. Flemming, iron haematoxylin. 1200 × .

Fig. 4. Vas deferens, tranverse section. Flemming, iron haematoxylin. 1200 × .

Fig. 5. Ejaculatory ducts, with common opening, transverse section. Flemming, iron haematoxylin. 1200 × .

Pl. XXI.

Fig. 1. *Pristina idrensis.* Stomach, longitudinal section. Flemming, iron haematoxylin. 560 × .

Fig. 2. *Pr. longiseta.* Stomach, stained *intra vitam* with neutral red. 450 × .

Fig. 3. *Pr. menoni.* Living. 20 × .

Fig. 4. *Pr. foreli.* Living. 20 × .

Fig. 5. *Pr. aequiseta.* Living, slightly pressed under a cover-glass. 30 × .

Fig. 6. *Pr. longiseta.* Living. 20 × .

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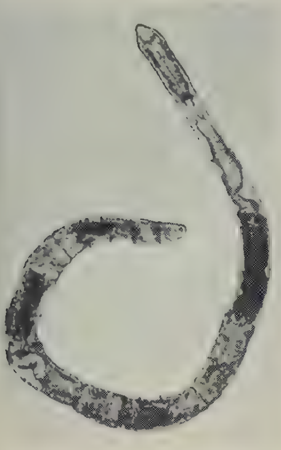

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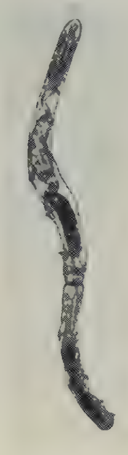

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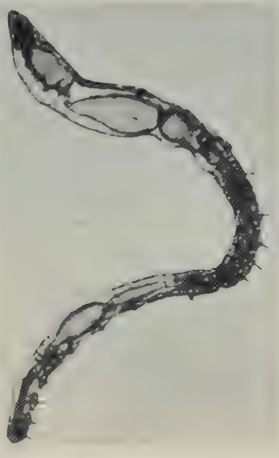

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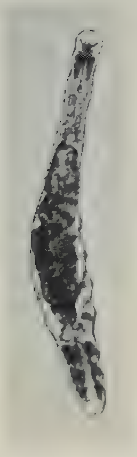

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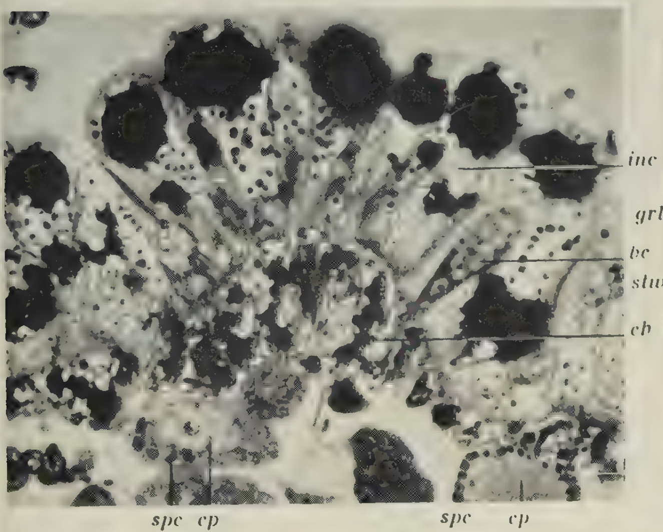
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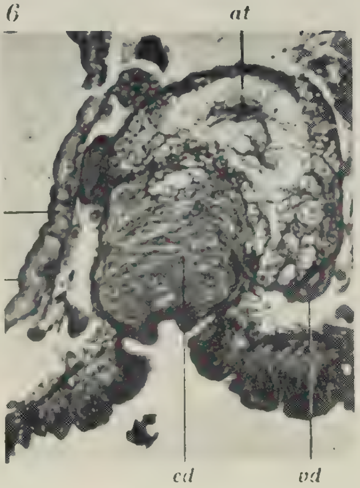

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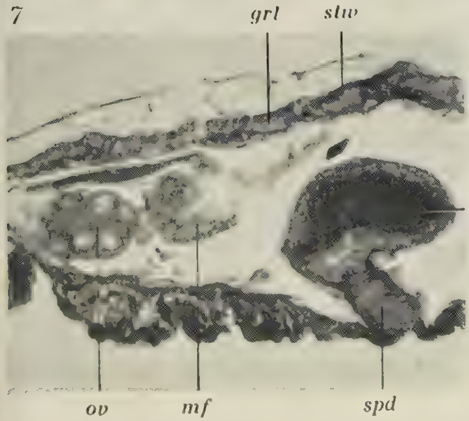
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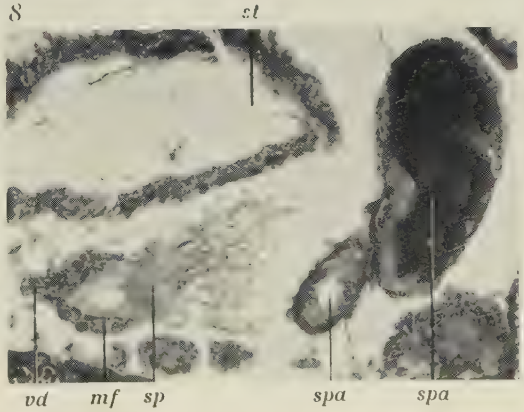
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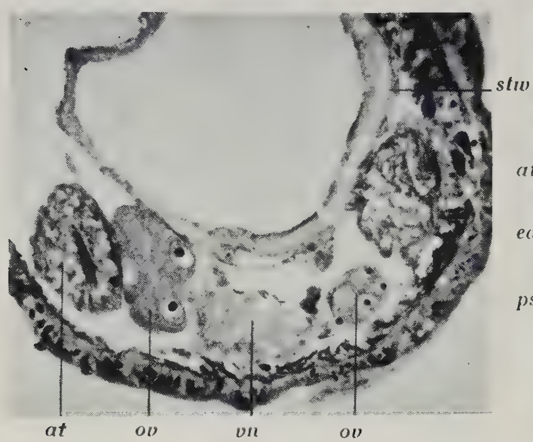
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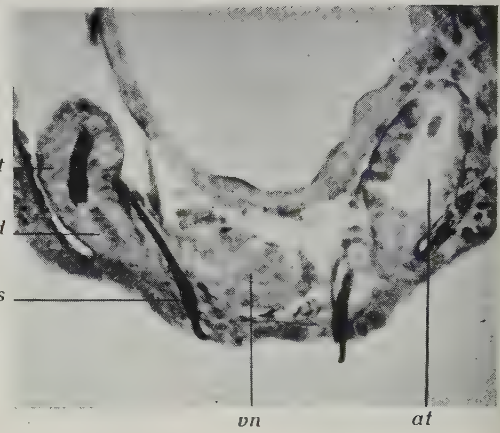
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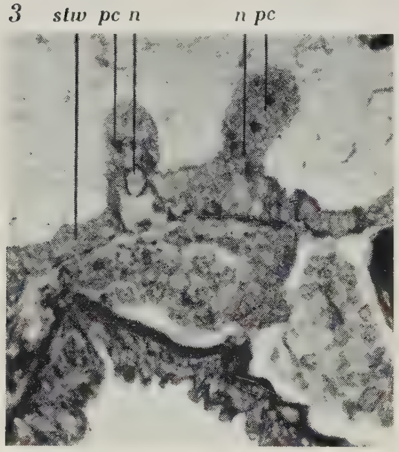

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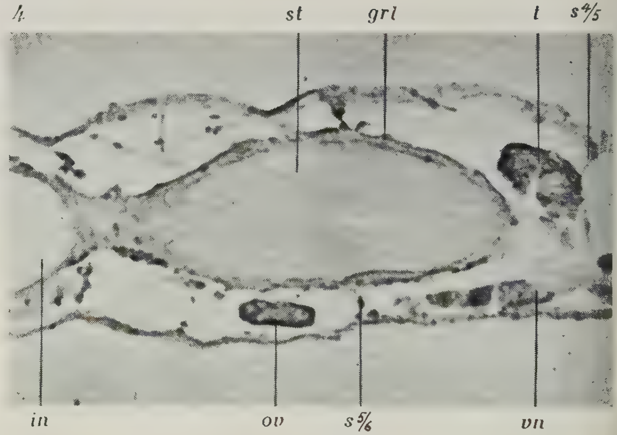
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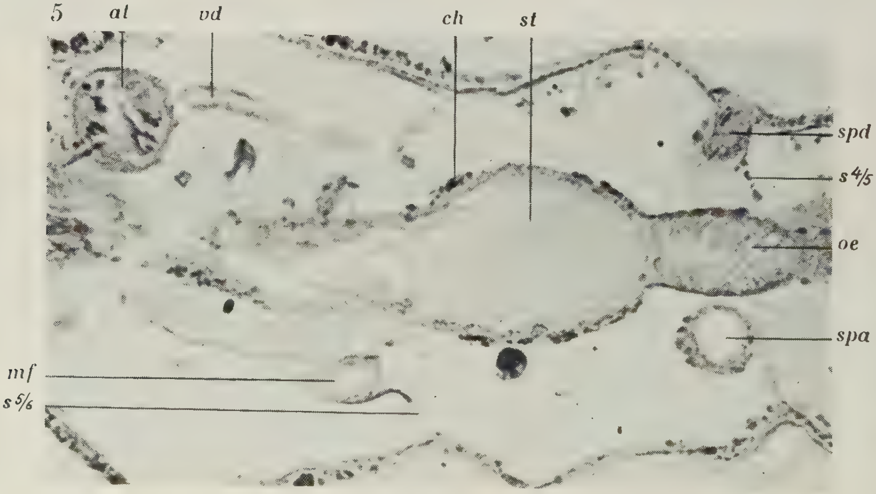
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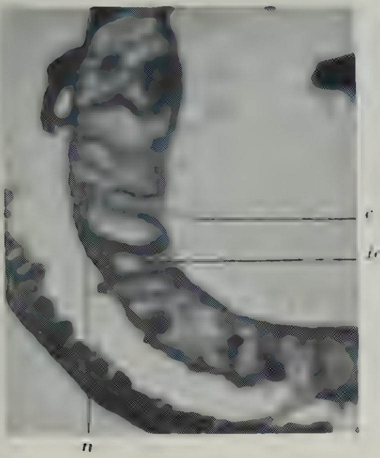

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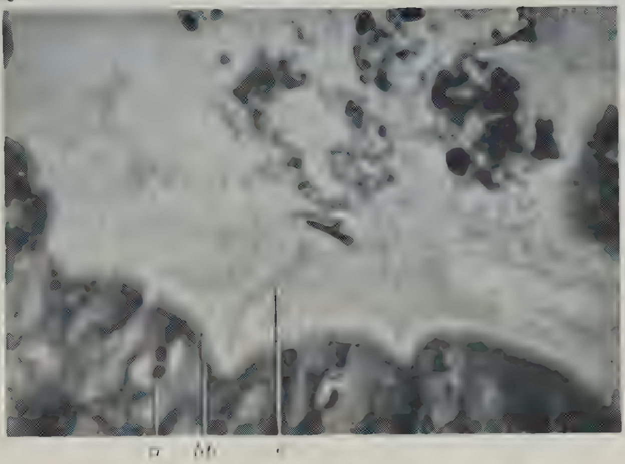

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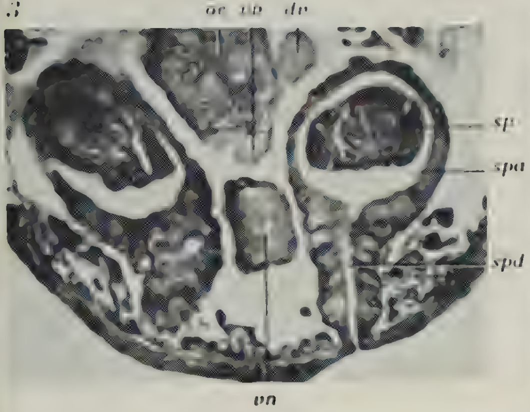
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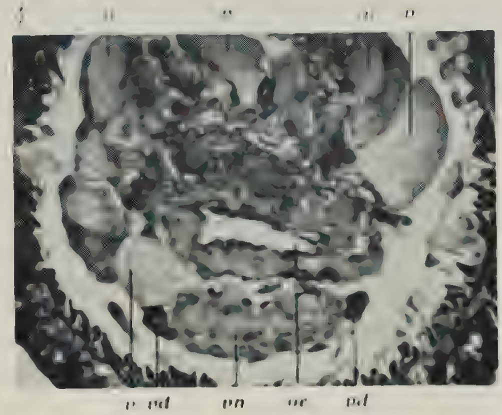
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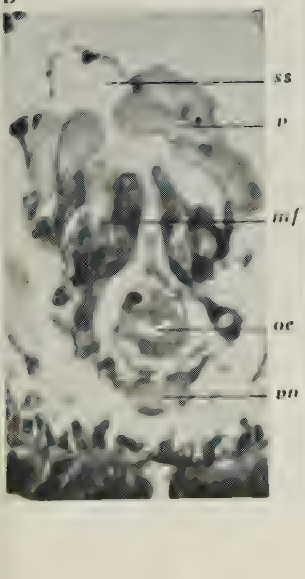

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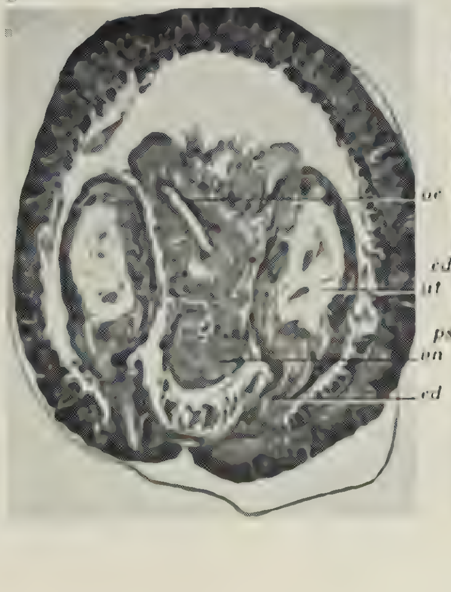
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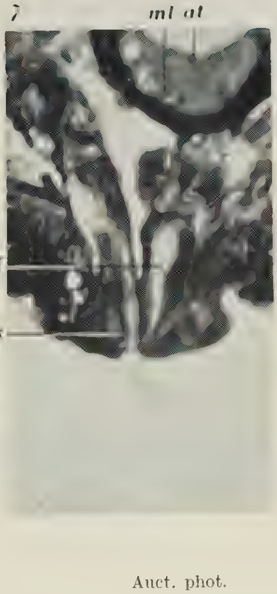

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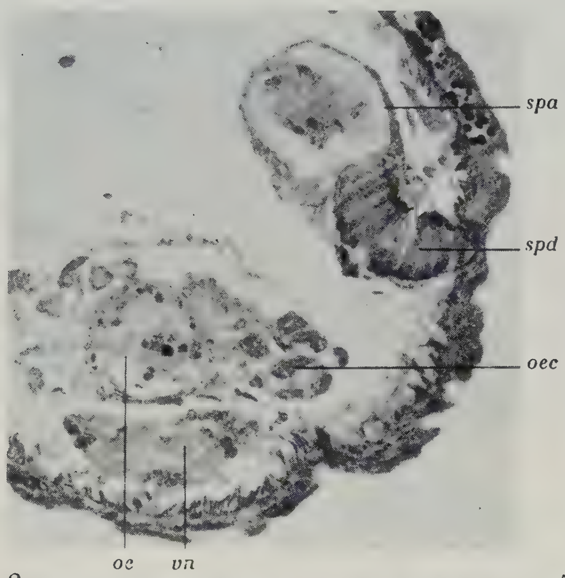
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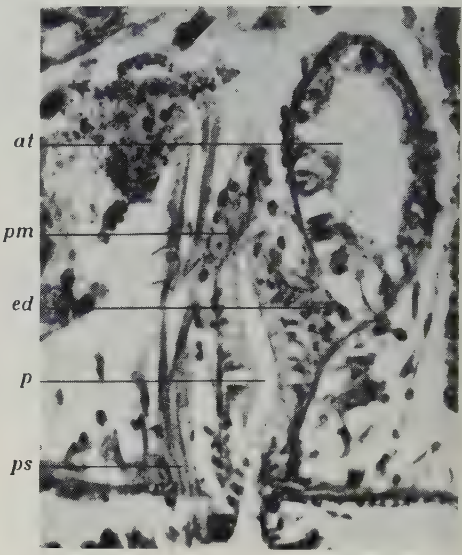

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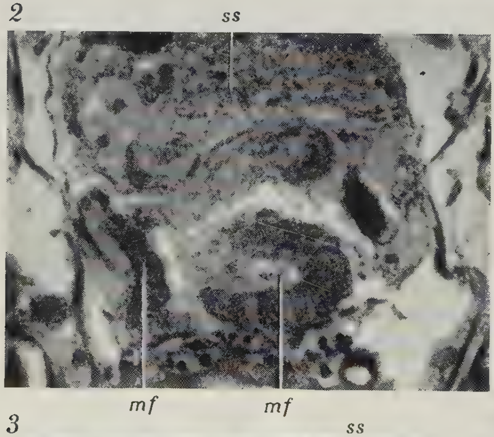

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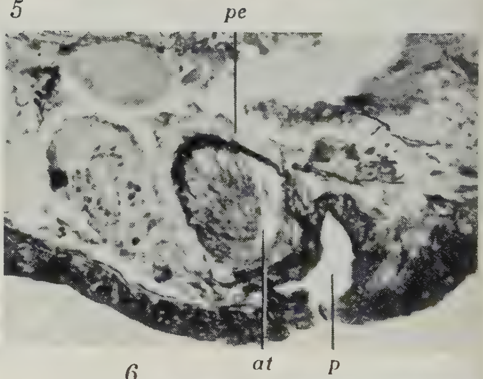

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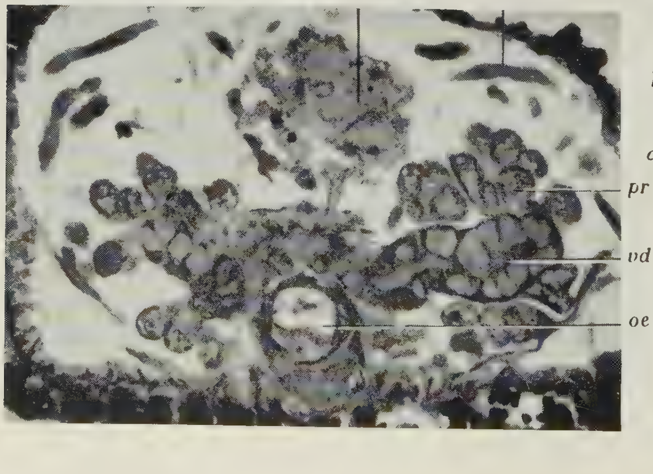

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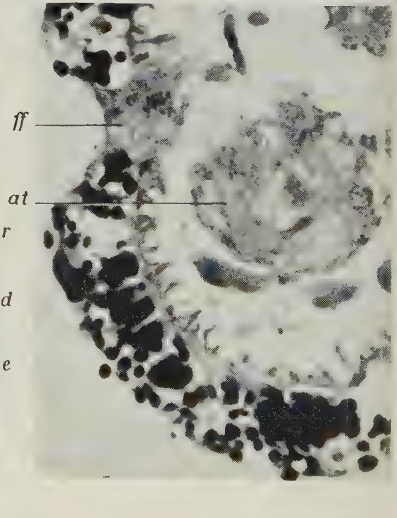

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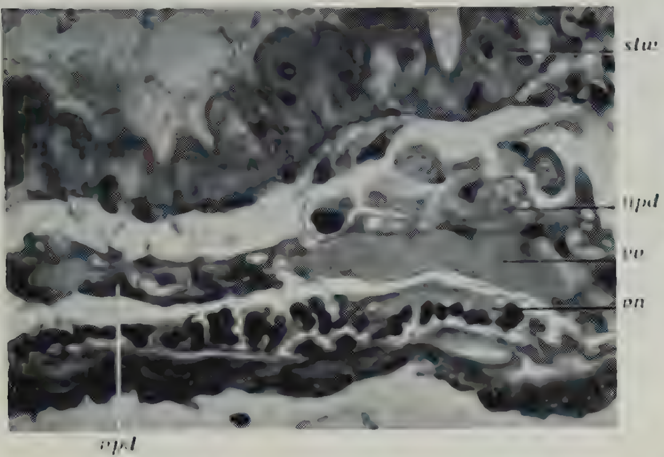
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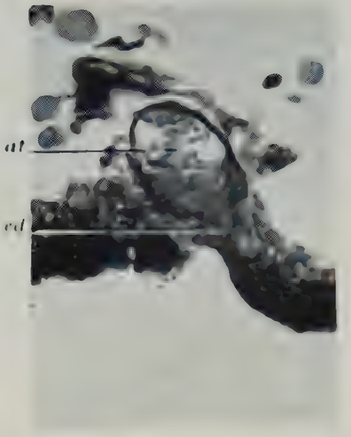

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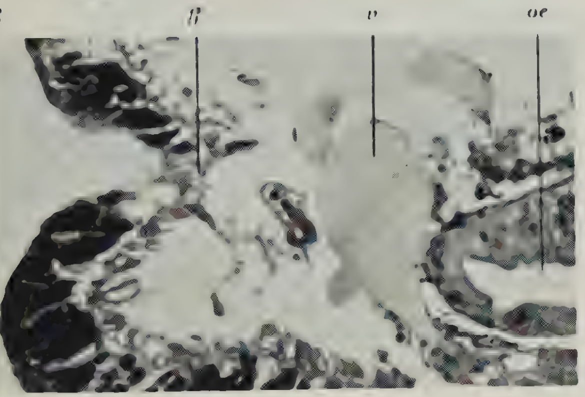

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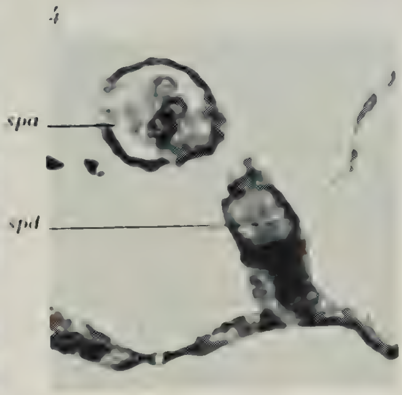

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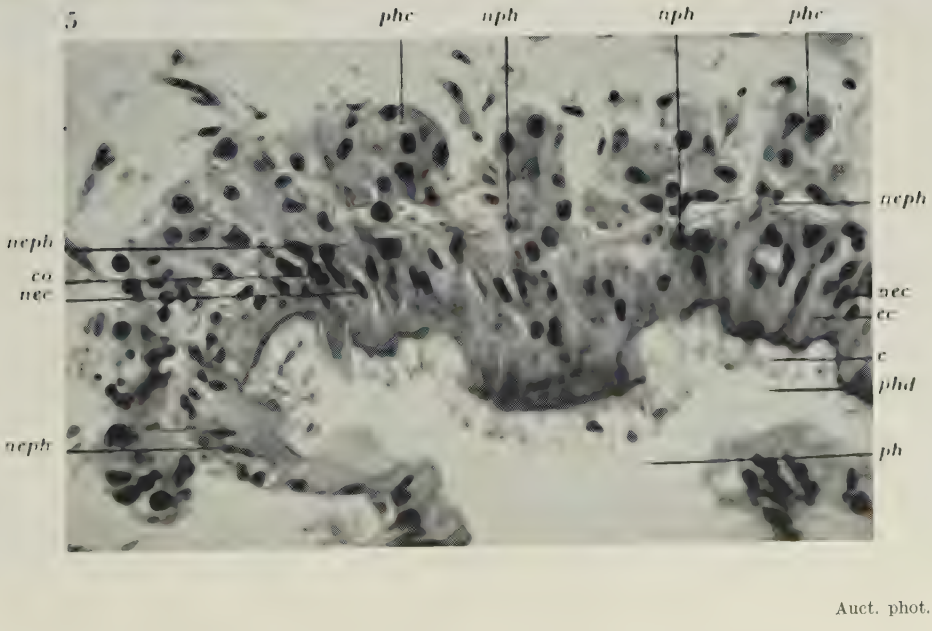
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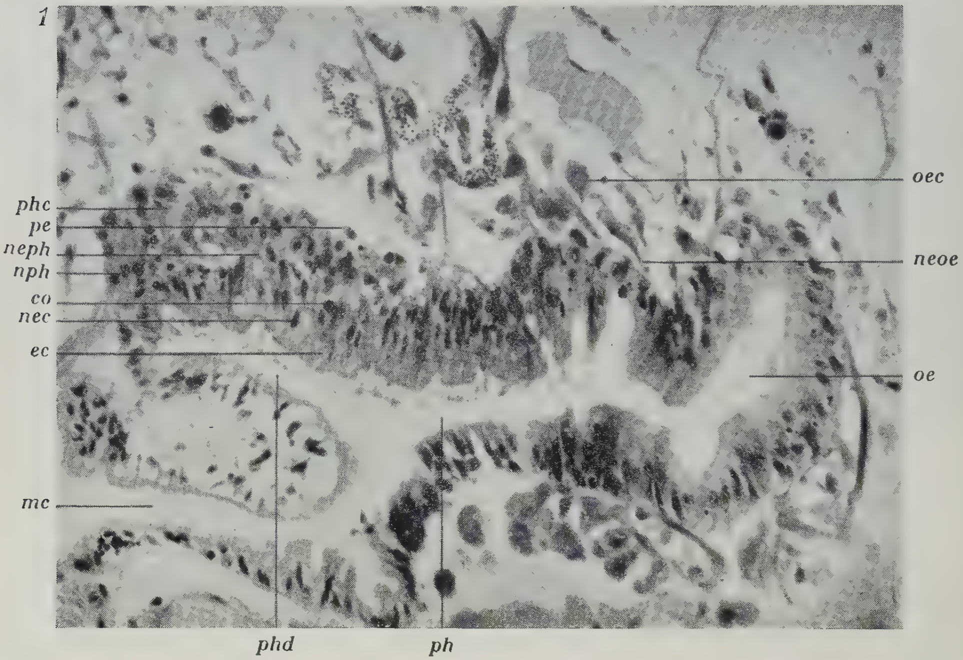
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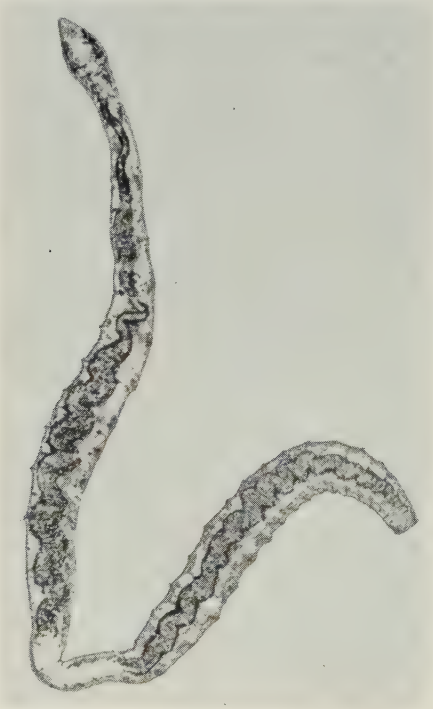

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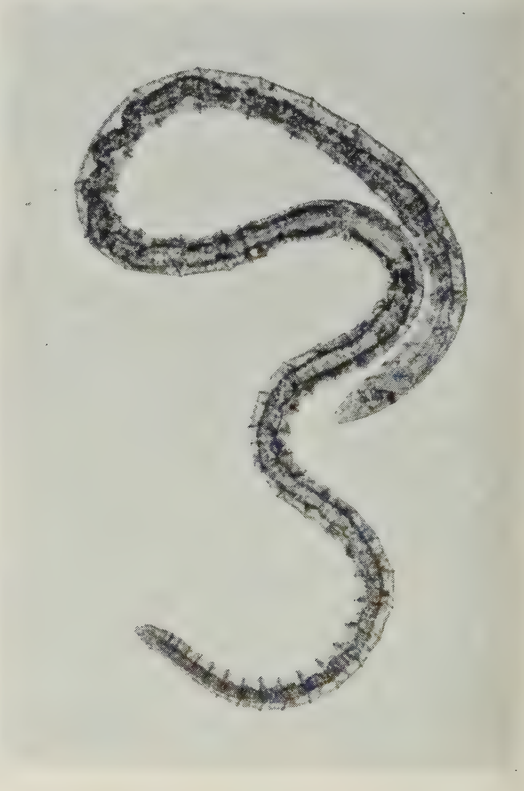

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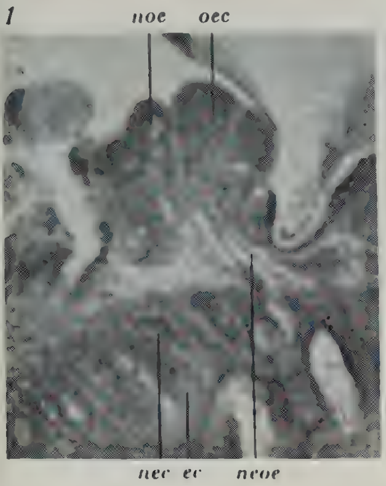
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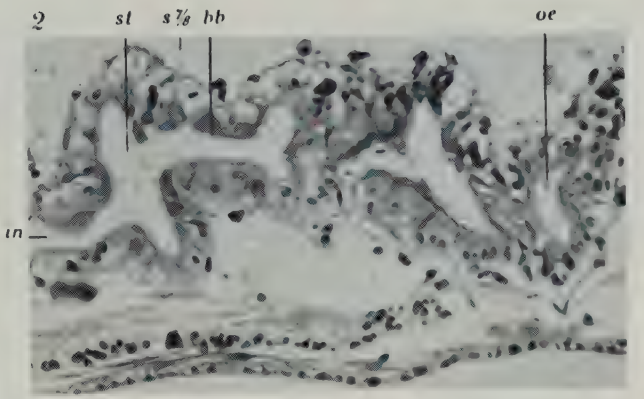
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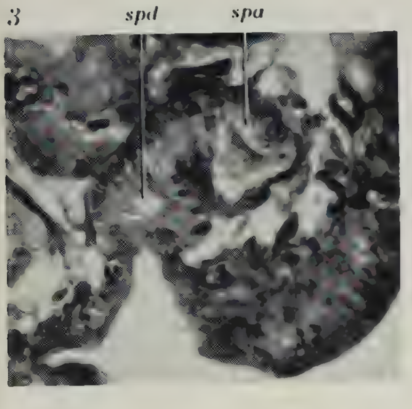

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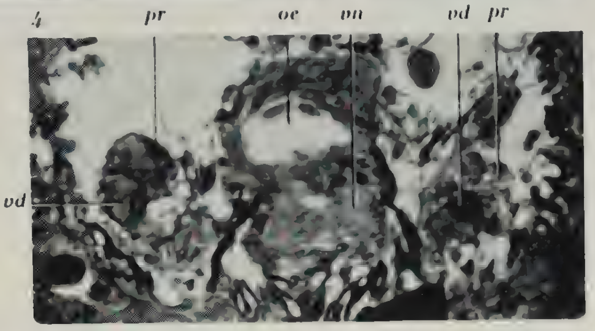
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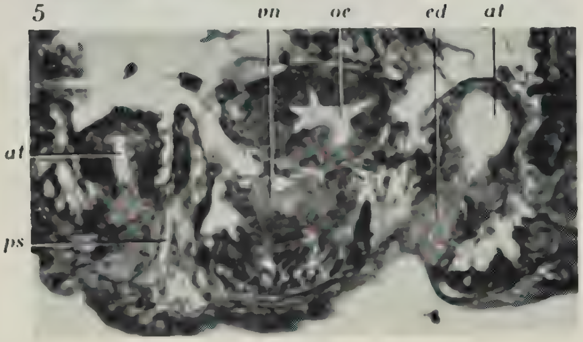
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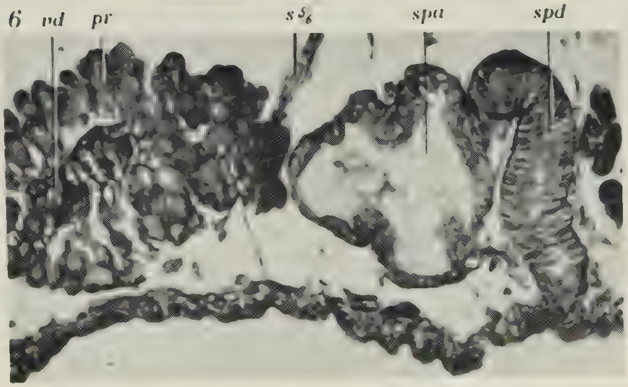
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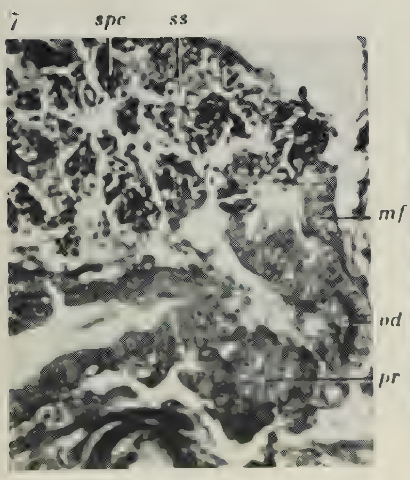
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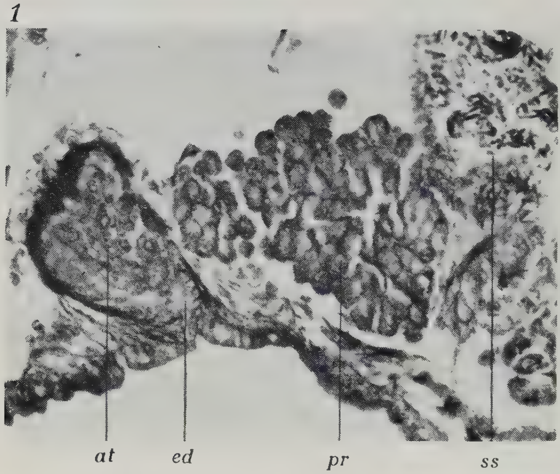

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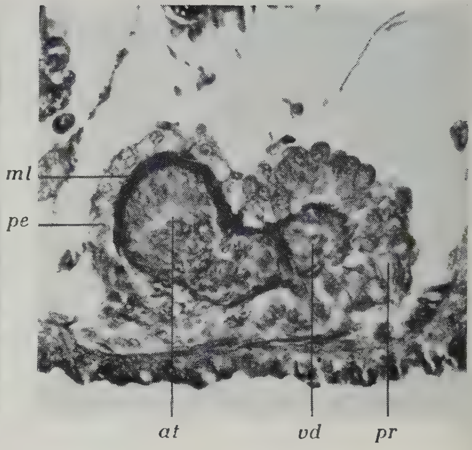
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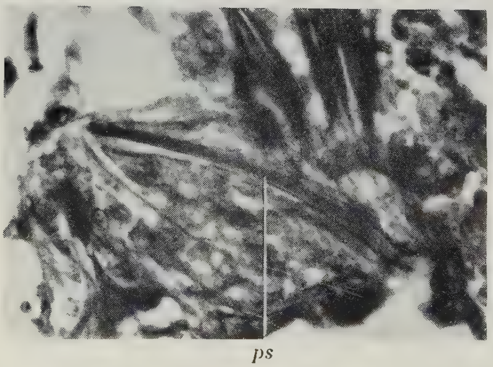

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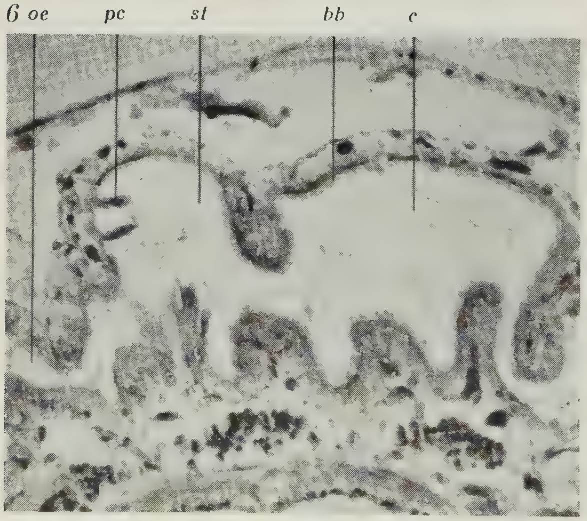

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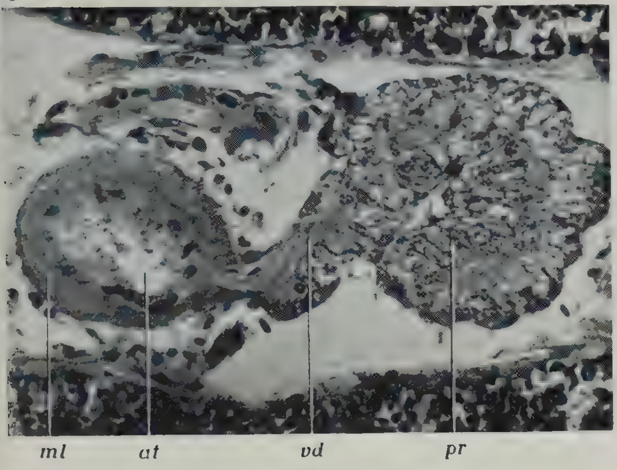

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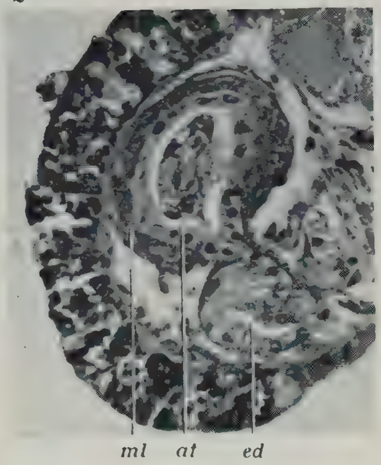

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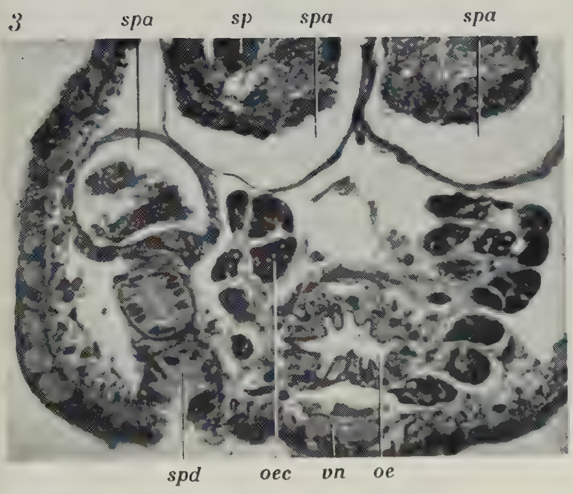
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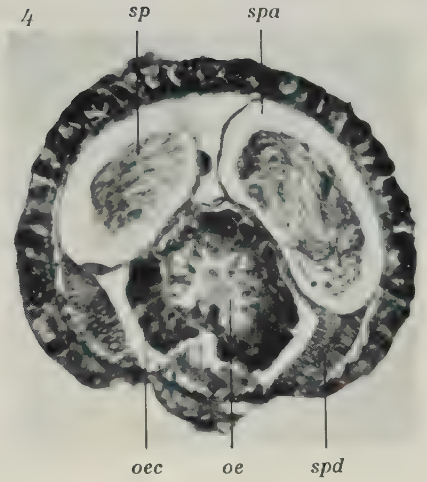
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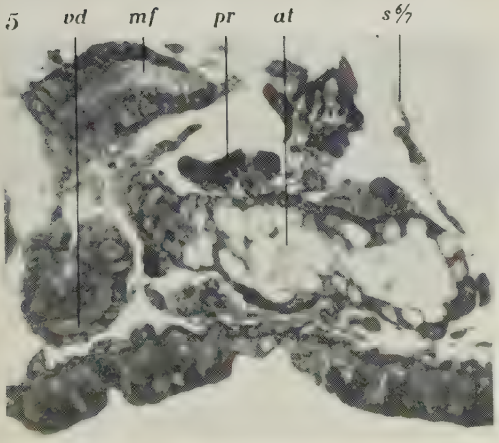
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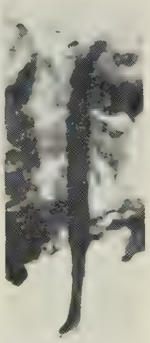

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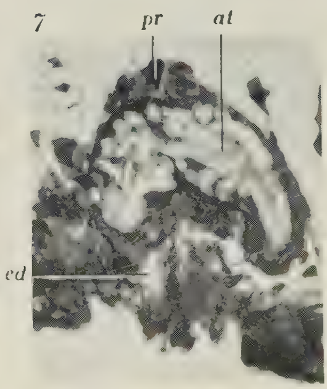

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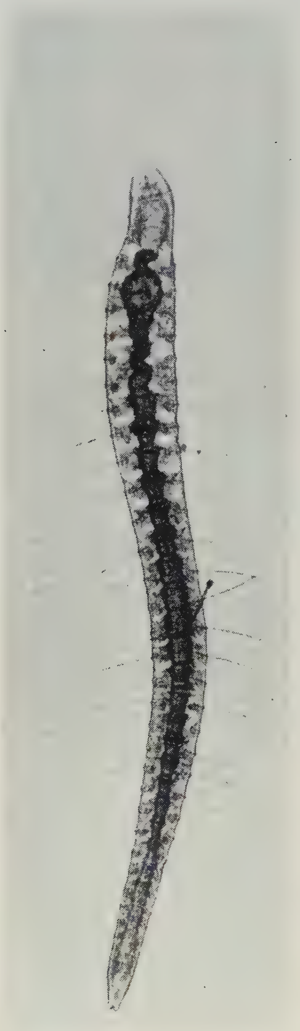

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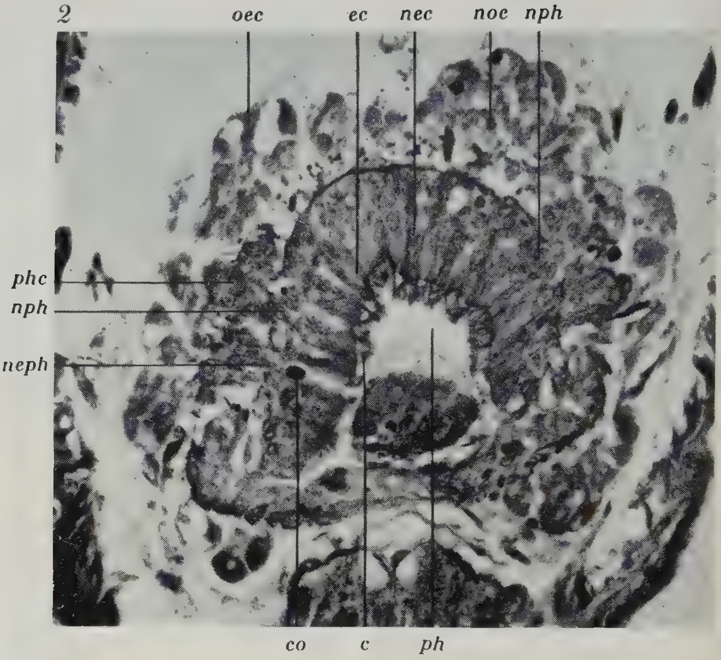
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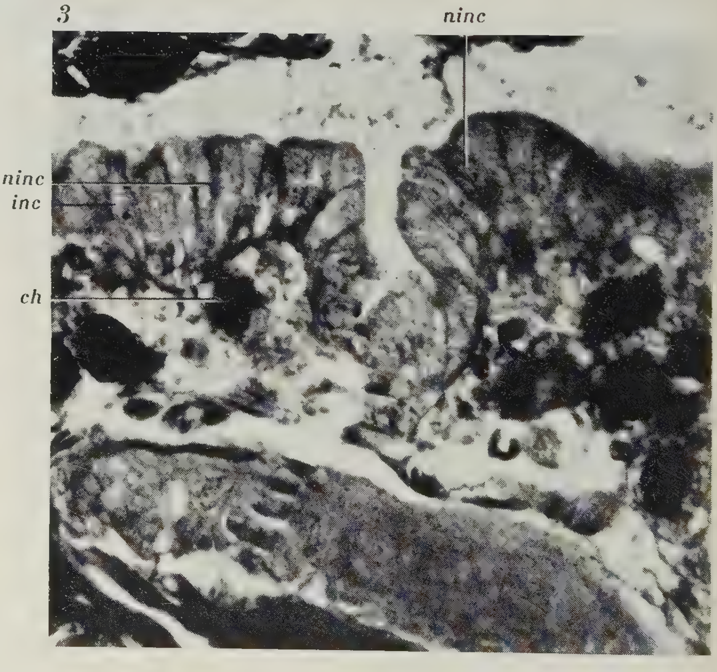
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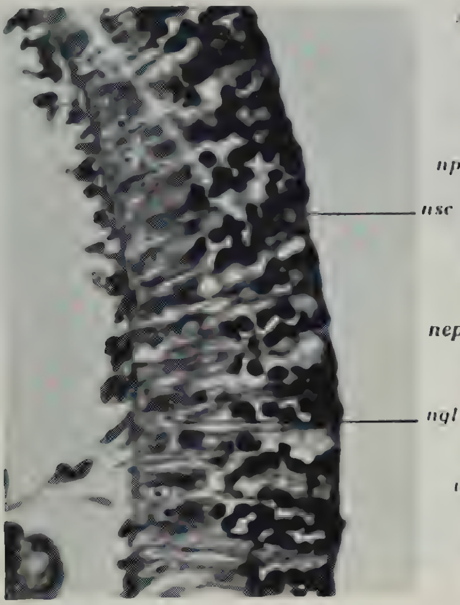

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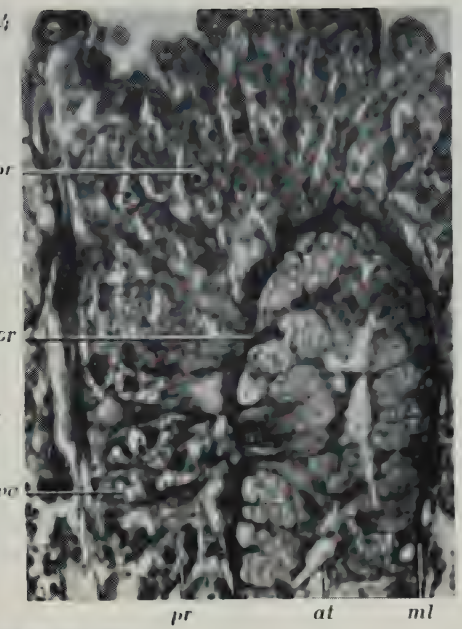
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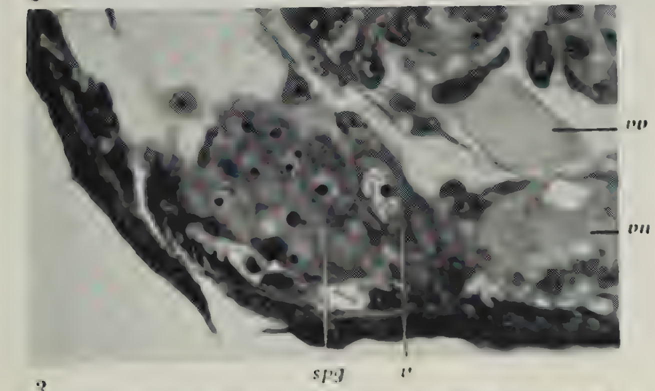

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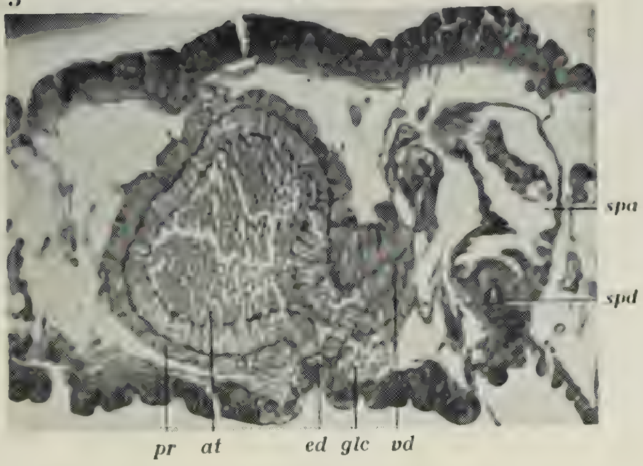
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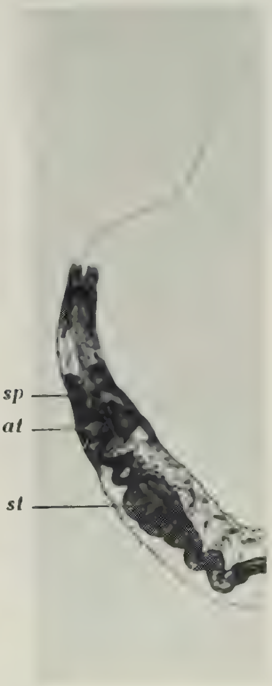

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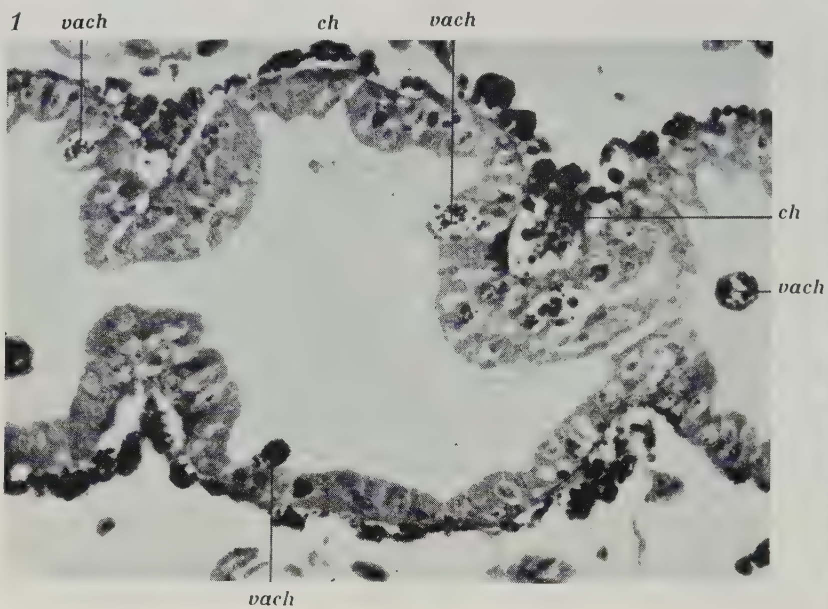
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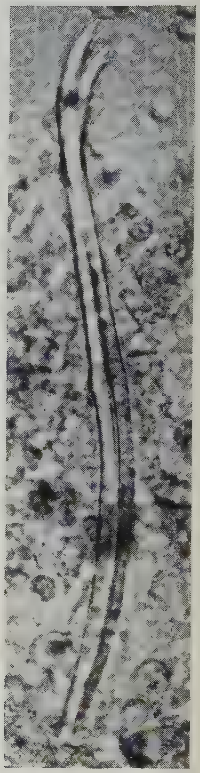

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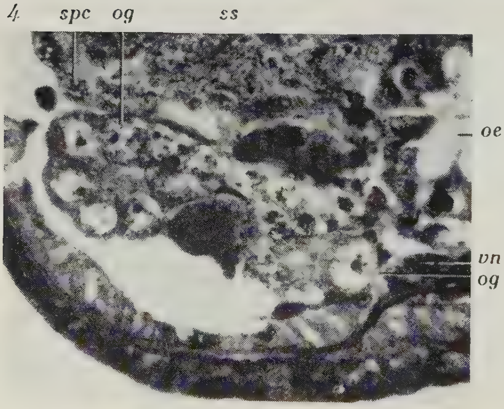
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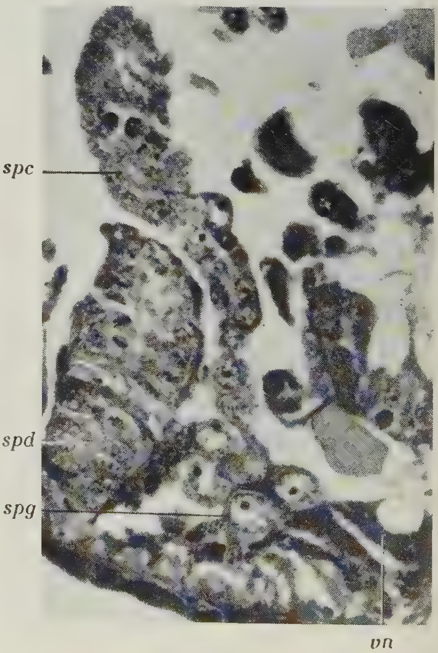
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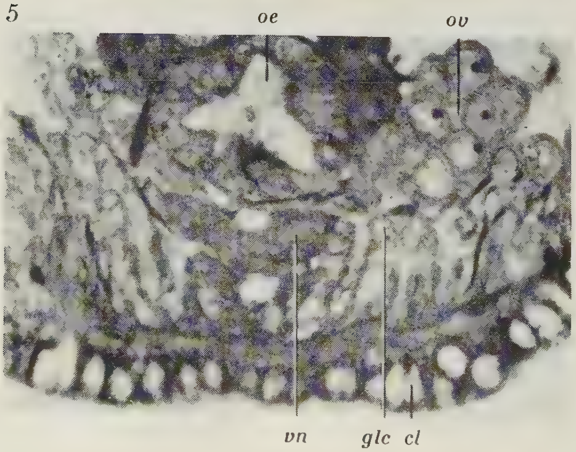
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PL. XIII.

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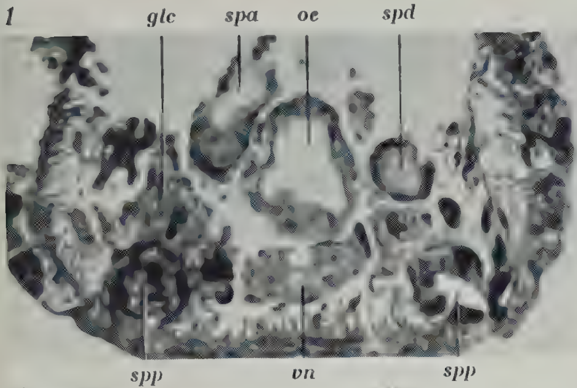
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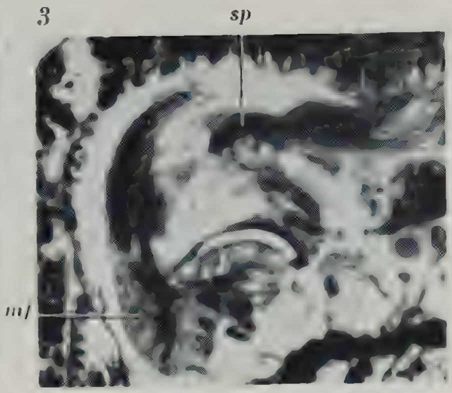

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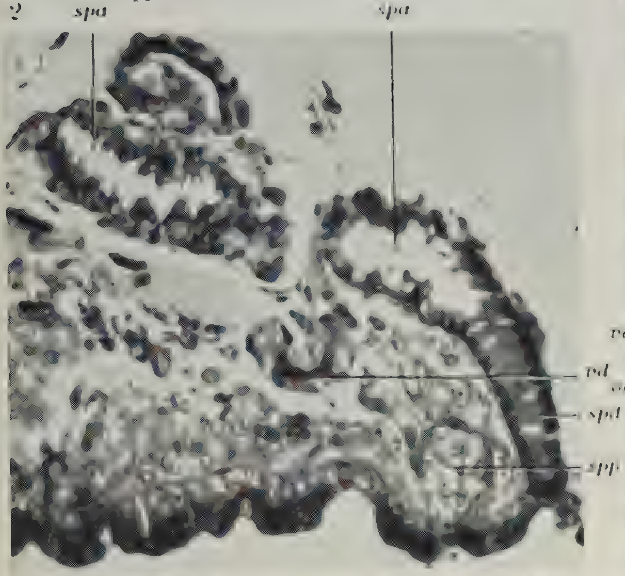
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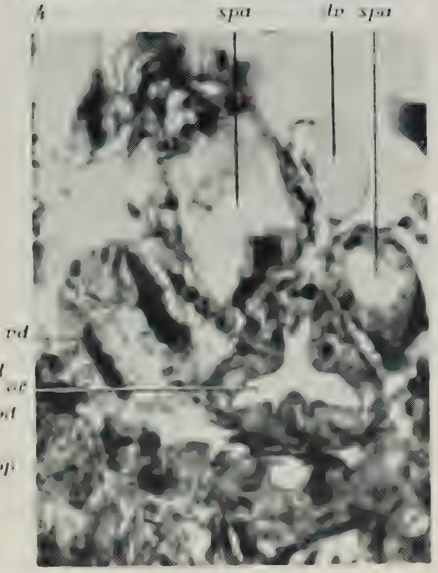
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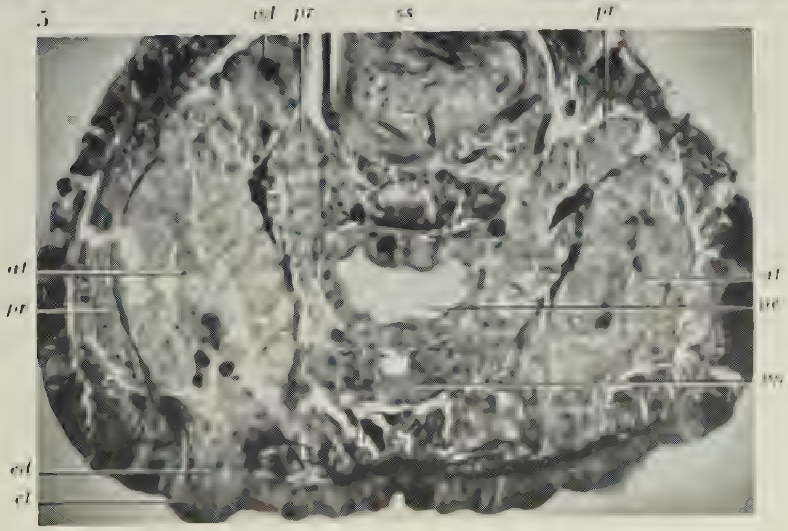
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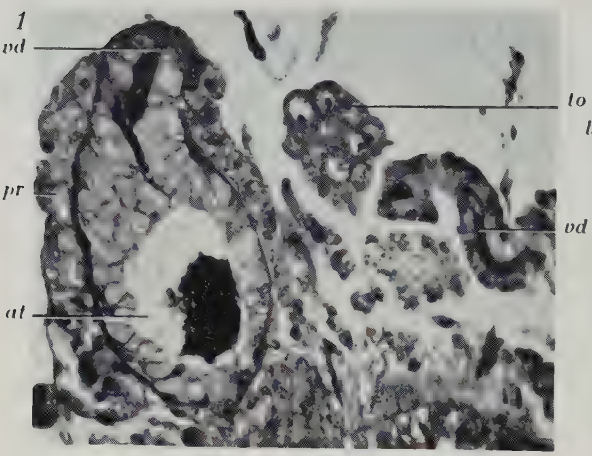
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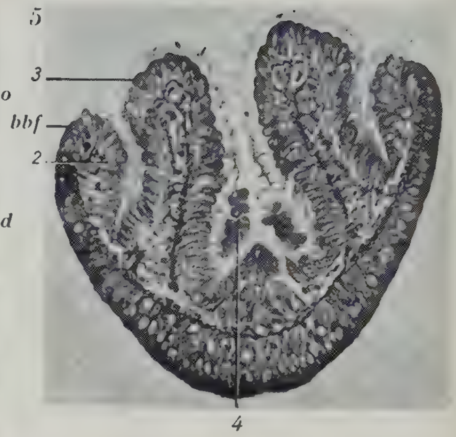

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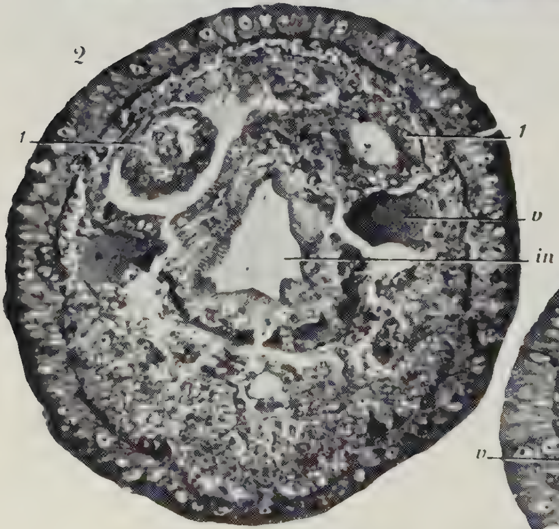

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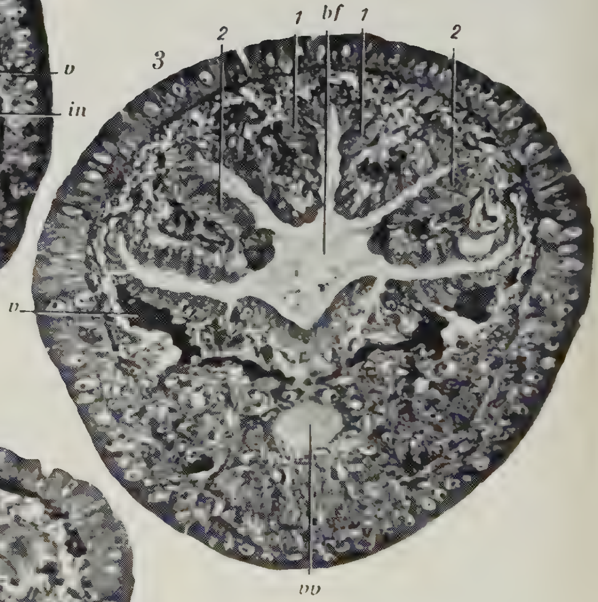

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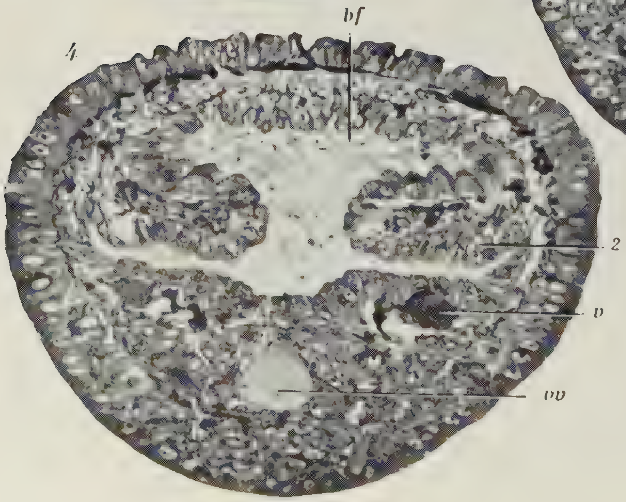

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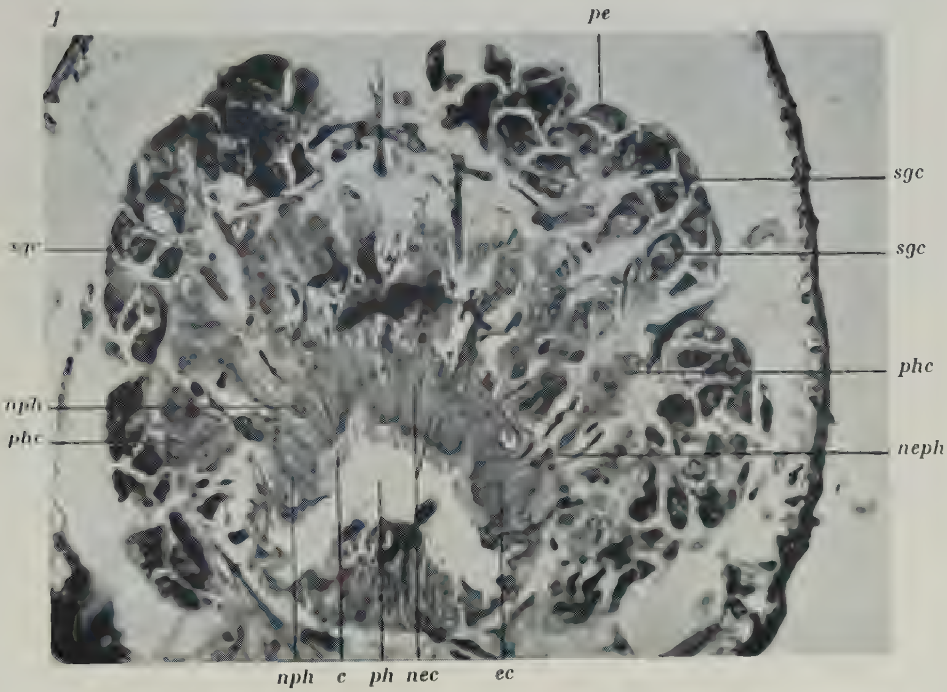
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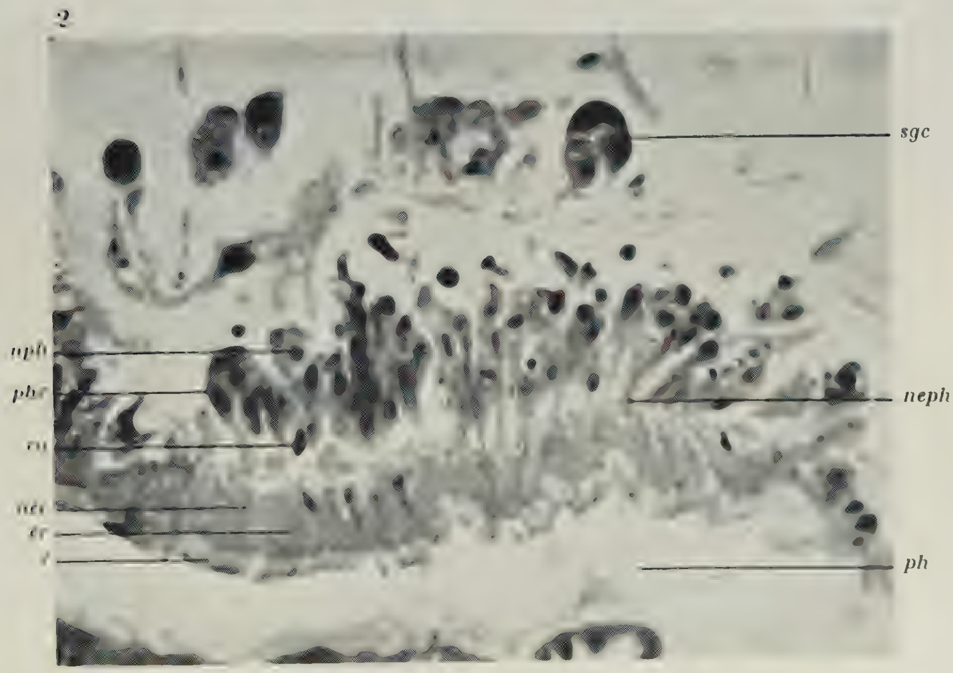
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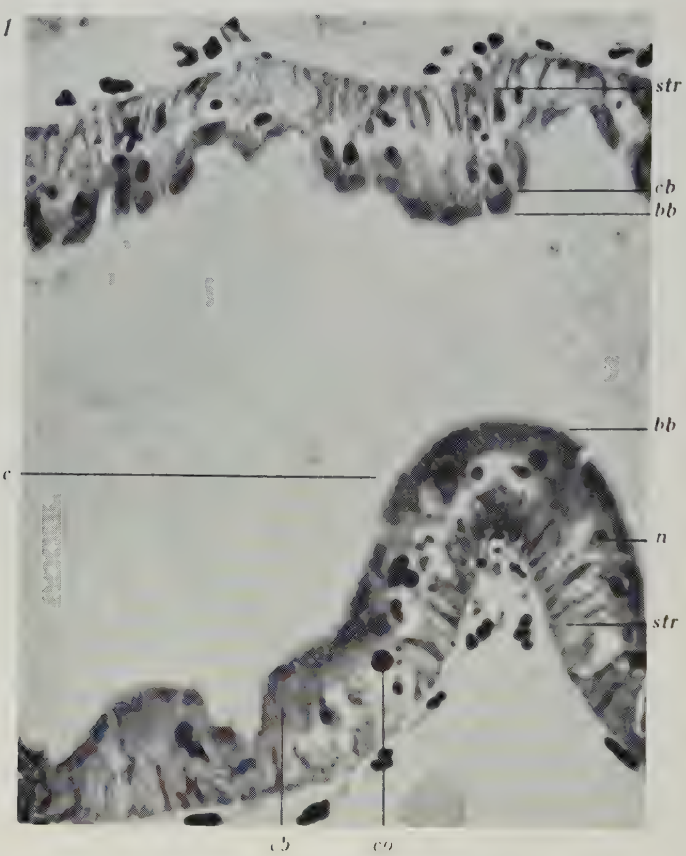
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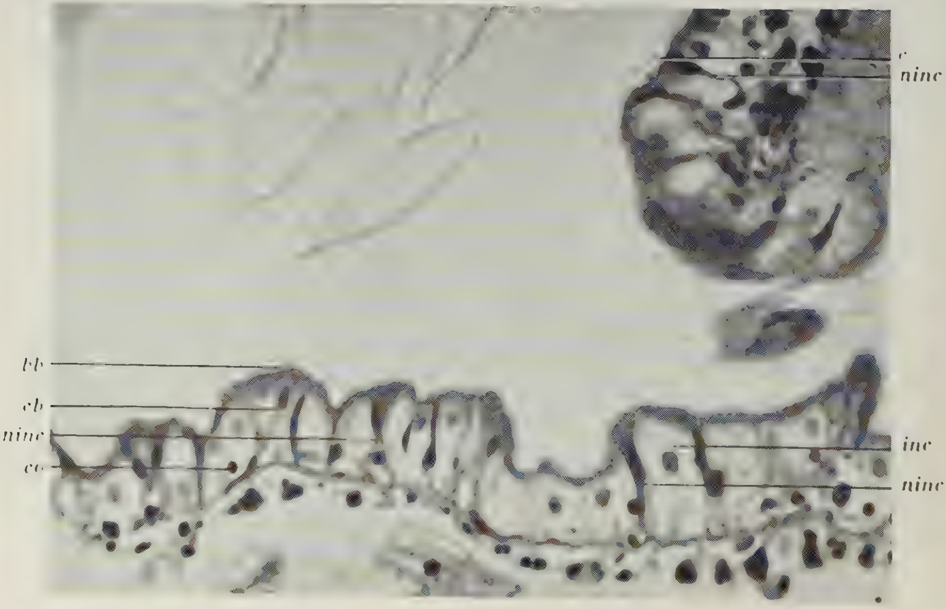
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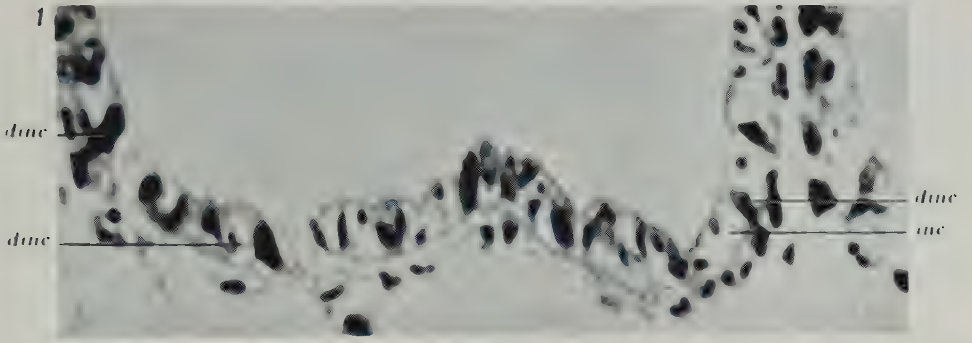
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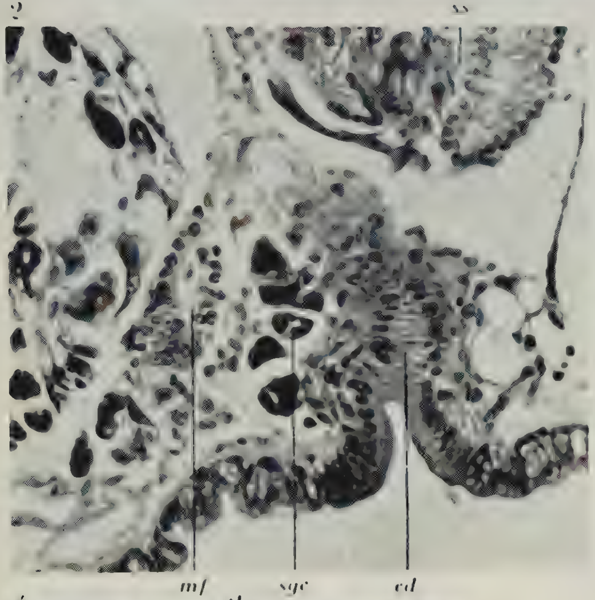

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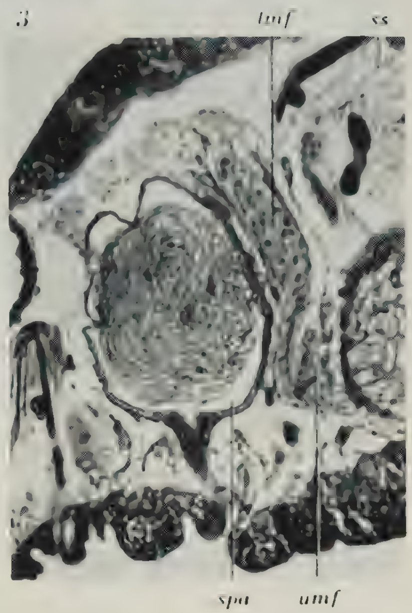
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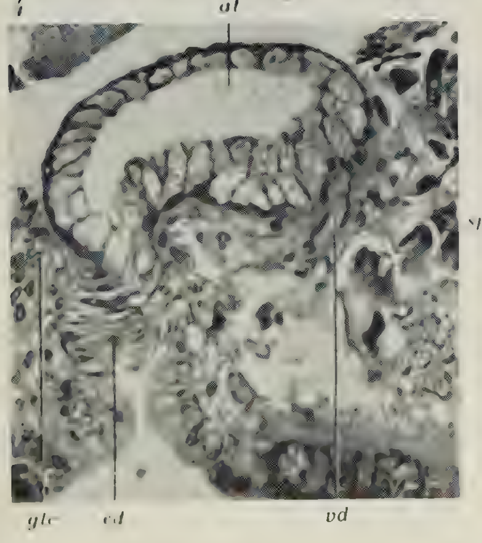

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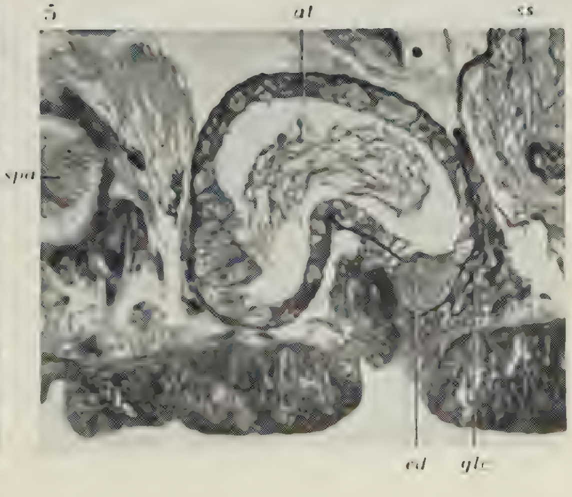
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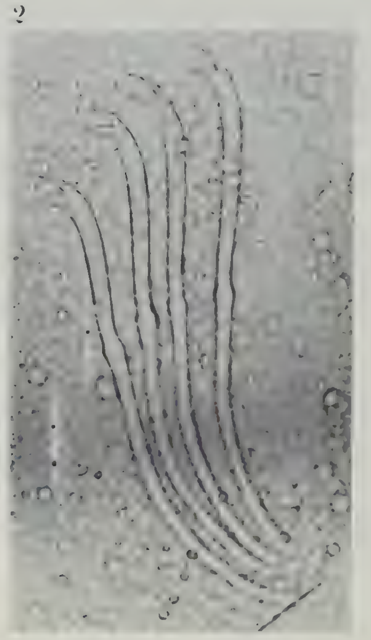

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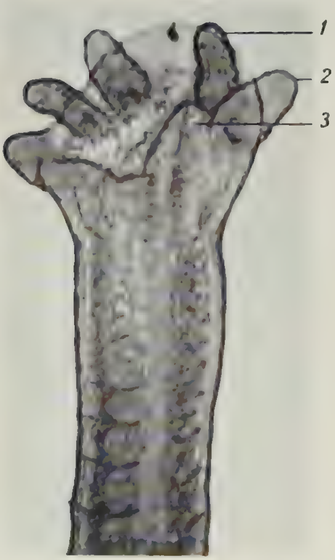

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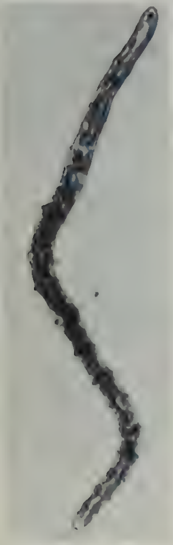

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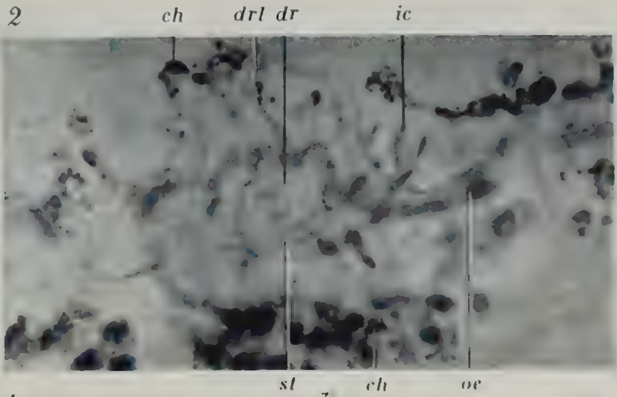
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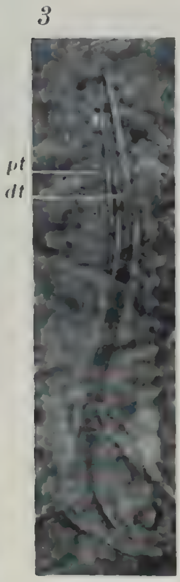

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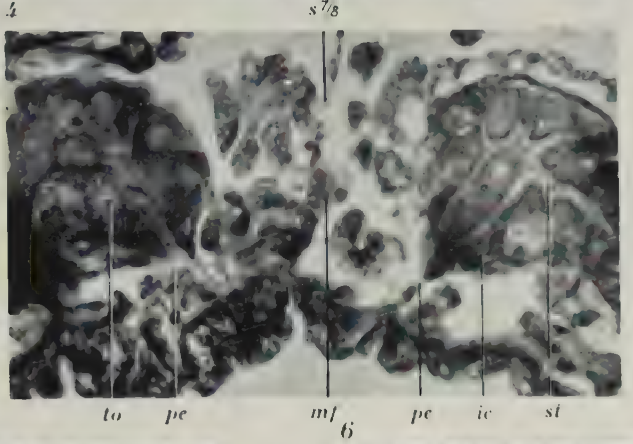
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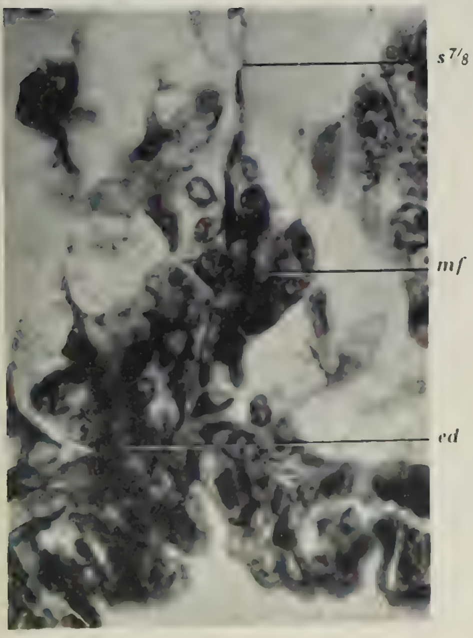

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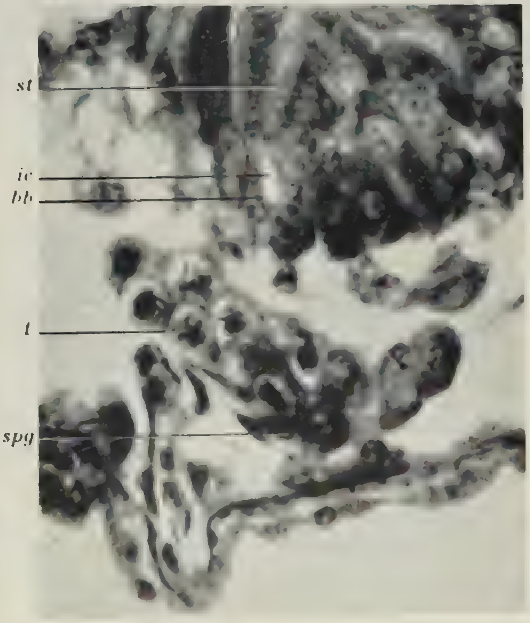
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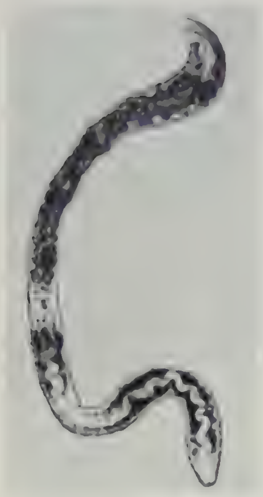

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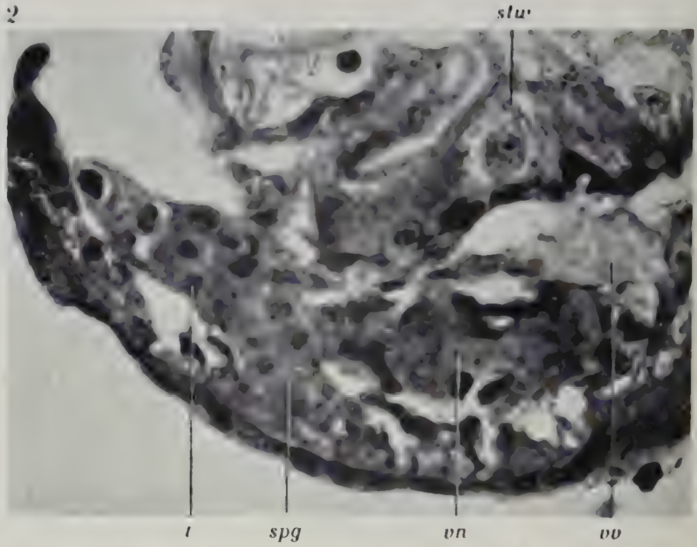
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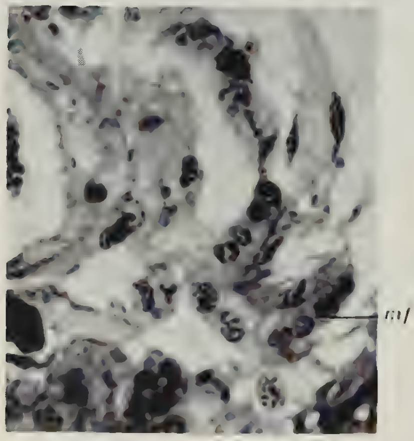

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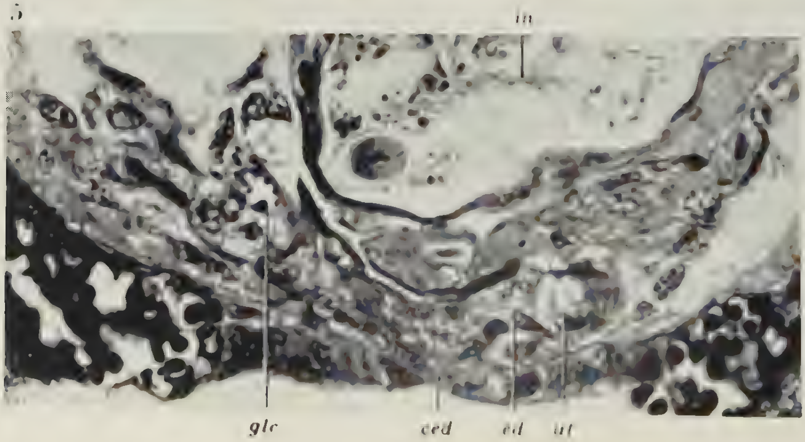
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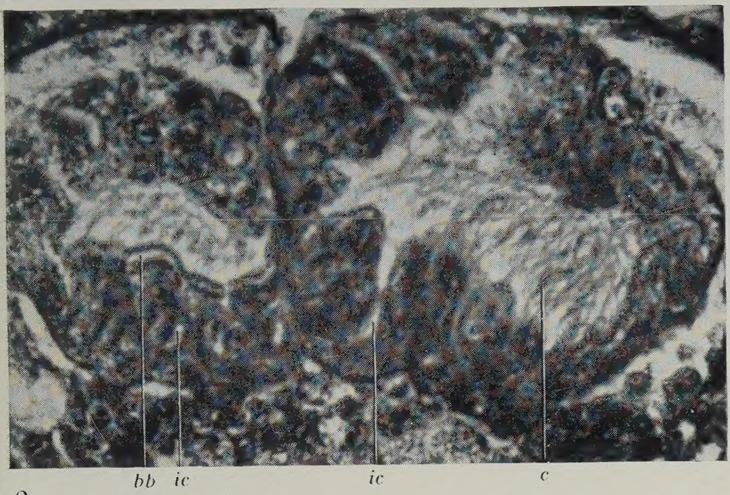

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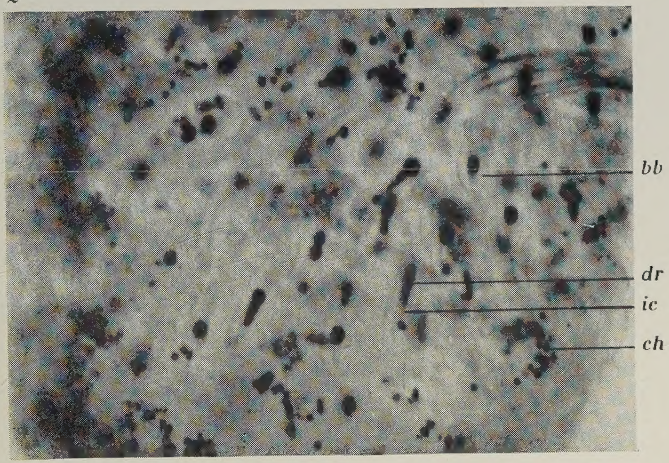

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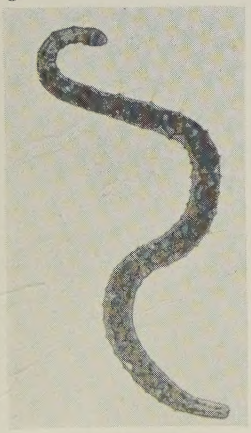

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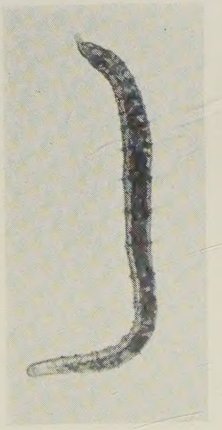

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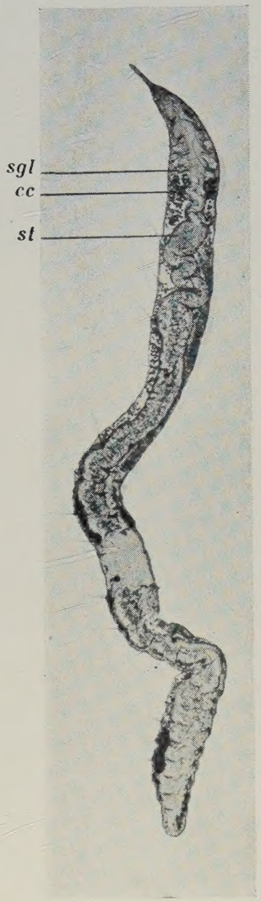

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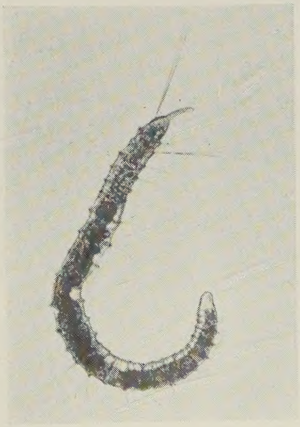

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